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THE PROVINCE OF ONTARIO

A Submission to the United States Environmental Protection Agency Hearings on Interstate Pollution Abatement

Washington, D.C.
June 19, 1981

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Ontario
Ministry of the Environment

Hon. Keith C. Norton, Q.C., Minister

Graham W. S. Scott, Q.C., Deputy Minister

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A submission to the United States Environmental Protection Agency hearing on interstate pollution abatement.

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Introduction

Representatives of the Ontario Ministry of the Environment presented technical evidence on transboundary air pollution to a hearing panel of the United States Environmental Protection Agency in Washington, D.C., on June 19, 1981.

The Ontario presentation had two main thrusts:

1. To illustrate the effects of transboundary pollution on the New York, Pennsylvania and Ontario regions.
2. To discuss Ontario's experiences in considering and controlling aggregated SO_2 sources in relation to transboundary pollution, and to show how Ontario has used long-range transport modelling in the consideration and control process.

Detailed, written evidence was to be provided to the EPA by August, 1981.

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   a) "How Our Decision-Making Employs Available Evidence, Including Modelling"

   b) "Summary of Recommendations"

   (The presentation also included illustrated comments and a film by Dr. Walter Lyons, Consultant to the Ministry - "A Description of Atmospheric Processes, Meteorological Patterns and Pollution Episodes Affecting Ontario, Pennsylvania, and New York: the Development of Evidence")

GRAHAM W.S. SCOTT, Q.C.
DEPUTY MINISTER
THE ONTARIO MINISTRY OF THE ENVIRONMENT

NOTES ON

TRANSBOUNDARY AIR POLLUTION

HEARINGS ON INTERSTATE POLLUTION ABATEMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C.
JUNE 19TH, 1981

FOR RELEASE AT 6:00 P.M.

MR. CHAIRMAN, MEMBERS OF THE PANEL:

AS A FRIEND AND CLOSE NEIGHBOUR OF THE AMERICAN PEOPLE, ONTARIO WELCOMES THIS OPPORTUNITY TO PARTICIPATE IN THESE PROCEEDINGS.

OUR APPEARANCE HERE TODAY IS SOMETHING OF A PRECEDENT. IT IS NOT COMMON FOR A DELEGATION FROM A PROVINCIAL GOVERNMENT TO APPEAR BEFORE ADMINISTRATIVE PROCEEDINGS IN ANOTHER COUNTRY. BUT THE MUTUAL PROBLEMS WHICH FACE US BOTH CALL FOR NEW APPROACHES AND BRING INTO QUESTION TRADITIONAL WAYS OF THINKING. ONTARIO IS AWARE, TOO, THAT THIS HEARING REPRESENTS A NEW DEPARTURE FOR THE ENVIRONMENTAL PROTECTION AGENCY IN THAT FOR THE FIRST TIME IT ADDRESSES THE QUESTION OF AGGREGATE IMPACT FROM A NUMBER OF POLLUTION SOURCES. WE FEEL THIS NEW INITIATIVE BY EPA IS ESSENTIAL IF THEY ARE TO MOVE TOWARDS A SUBSTANTIAL PROGRAM TO REDUCE EMISSIONS IN SEVERAL STATES.

THE U.S. LEGISLATORS WHO ENACTED SECTION 115 OF THE CLEAN AIR ACT IN ITS ORIGINAL FORM IN 1970 SHOWED GREAT FORESIGHT IN ADDRESSING TRANSBOUNDARY AIR POLLUTION. CONGRESS RECOGNIZED THE INCREASING SEVERITY OF THE PROBLEM IN 1977 BY AMENDING THE PROVISION TO MAKE IT MORE EFFECTIVELY ENFORCEABLE.

OUR PRESENTATION THIS EVENING OFFERS EVIDENCE RELEVANT TO PETITIONS BY NEW YORK AND PENNSYLVANIA AND HAS SEVERAL OBJECTIVES:

1. TO DEMONSTRATE THAT U.S. INDUSTRIAL EMISSIONS INCLUDING SO_2 AND PARTICULATES ARE BEING TRANSPORTED THROUGH A LARGE AIRSHED WHICH INCLUDE AREAS OF NEW YORK AND PENNSYLVANIA AND ONTARIO;

2. TO SHOW THE EFFECT OF THE TRANSPORTED MATERIAL ON THE ENVIRONMENT;

3. TO INDICATE HOW ONTARIO IS DEALING WITH THE PROBLEM WITHIN ITS JURISDICTION;

4. TO CONVEY TO YOU OUR VIEW THAT THERE IS NEED TO RETHINK THE CURRENT REGULATORY MECHANISMS DEALING WITH INDUSTRIAL POLLUTANTS AND TO CONSIDER THE FOLLOWING ISSUES:
   (A) MULTIPLE VS. SINGLE POINT SOURCES;
   (B) LONGER-RANGE AS WELL AS SHORT-RANGE TRANSPORT;
   (C) THE CONNECTION BETWEEN PRIMARY AND SECONDARY POLLUTANTS;
   (D) TRANSBOUNDARY POLLUTION.

5. TO PROPOSE A LEGAL FRAMEWORK FOR THE RESOLUTION OF PROBLEMS COVERED BY THIS HEARING AND OTHER ASSOCIATED TRANSBOUNDARY PROBLEMS;

6. TO PERSUADE YOU TO IMPLEMENT A POLICY WHICH:
   (A) ENCOURAGES VIGOROUS ENFORCEMENT OF CURRENT REGULATIONS;
   (B) DISCOURAGES ANY RELAXATION IN THESE REGULATIONS;
   (C) ACHIEVES REDUCTION IN EMISSIONS WHICH WE BELIEVE TO BE NECESSARY.

CANADIAN PROVINCES ARE RESPONSIBLE FOR MANAGING THEIR OWN AIR QUALITY AND ONTARIO HAS DEVELOPED ITS OWN AMBIENT AIR QUALITY CRITERIA AND REGULATORY FRAMEWORK.

A LOOK AT THE MAP SHOWS THAT ONTARIO IS WEDGED BETWEEN A GROUP OF STATES WHICH ARE HIGHLY INDUSTRIALIZED. WIND DIRECTIONS INTO AND ACROSS ONTARIO HAVE A WESTERLY PREVALENCE. AIR MASSES HEAVILY LADENED WITH INDUSTRIAL EMISSIONS AND OFTEN RESULTING IN PRECIPITATION IN ONTARIO FREQUENTLY ORIGINATE FROM THE SOUTH AND SOUTHWEST.

OUR PRESENCE HERE UNDERLINES OUR VIEW THAT ATMOSPHERICALLY BORNE POLLUTANTS LIKE SO_2 ARE A PROBLEM WHICH INVOLVES US ALL.

AIRSHEDS CAN NO LONGER BE CONSIDERED AS AN ENTITY WITH LOCALIZED BOUNDARIES AND SUBJECT TO MANAGEMENT BASED ON A LOCAL RATIONALE. IN THE CASE OF ATMOSPHERICALLY CONVEYED POLLUTANTS WE SHARE A COMMON AIRSHED. THUS, POLLUTION CONTROL TO PROTECT THE NORTH AMERICAN ENVIRONMENT MUST BE A SHARED RESPONSIBILITY AND COMMITMENT.

CLEARLY ONTARIO HAS A REAL INTEREST IN THESE PROCEEDINGS. ONE NEEDS ONLY TO CONSIDER THE DAMAGE ALREADY DONE TO OUR RECREATIONAL AREAS AND AGRICULTURAL ZONES WHICH ARE SENSITIVE TO ATMOSPHERIC POLLUTANTS. IF FUTURE DAMAGE IS TO BE PREVENTED THEN A REDUCTION OF EMISSIONS IS NEEDED ON AN EASTERN NORTH AMERICAN BASIS.

WE UNDERSTAND THAT THE HEARINGS ARE BEING CONDUCTED UNDER THE AUTHORITY OF SECTION 136 OF THE CLEAN AIR ACT. THIS PROVIDES A MECHANISM FOR ANY STATE, IN THIS CASE NEW YORK AND PENNSYLVANIA, TO PETITION THE EPA TO DETERMINE WHETHER A MAJOR POLLUTION SOURCE IN ANOTHER STATE IS CAUSING AN INTERSTATE POLLUTION PROBLEM. THE HEARING NOTICE ALSO INDICATES THAT EPA UNDER SECTION 126 CAN ONLY REGULATE EMISSIONS SHOWN TO PREVENT ATTAINMENT OR MAINTENANCE OF A NATIONAL STANDARD OR INTERFERE WITH MEASURES TO PREVENT SIGNIFICANT DETERIORATION OR PROTECT VISIBILITY.

THE SCOPE OF THE HEARING AS DEFINED BY THESE TERMS OF REFERENCE IS THEREFORE LIMITED TO SO_2, TOTAL SUSPENDED PARTICULATES AND VISIBILITY WITH REFERENCE TO THE PETITIONING STATES, NEW YORK AND PENNSYLVANIA. THESE TERMS OF REFERENCE DO NOT PROVIDE AN OPPORTUNITY FOR US TO MAKE OUR FULL CASE WITH RESPECT TO TRANSBOUNDARY POLLUTION AND IN PARTICULAR ACID PRECIPITATION AND ITS EFFECTS ON ONTARIO. WE ALSO UNDERSTAND THAT THE EPA REGARDS THESE PROCEEDINGS UNDER SECTION 126 AS BEING ENTIRELY SEPARATE FROM SEVERAL PROPOSED STATE IMPLEMENTATION PLANS AMENDMENTS NOW UNDER CONSIDERATION BY EPA AND IN RESPECT OF WHICH ONTARIO HAS FILED SUBMISSIONS. WE DO NOT SEE HOW THESE MATTERS CAN, IN PRACTICE, BE TREATED IN ISOLATION FROM EACH OTHER SINCE THE SO_2 EMISSIONS FROM THE SAME SOURCES ARE AN ISSUE IN EACH CASE.

BASED ON OUR SCIENTIFIC EXPERIENCE WE FEEL THAT THERE IS A CLEAR NEED TO TAKE AN INTEGRATED AND BROAD VIEW OF THE MANY ASPECTS OF THE PROBLEM OF LONG-RANGE TRANSPORT OF ATMOSPHERIC POLLUTANTS. FOR THIS REASON WE FILED WITH EPA ON MAY 28, 1981, A REQUEST "THAT EPA EXPAND THE SCOPE OF THE HEARINGS IT HAS ANNOUNCED UNDER SECTION 126 OF THE CLEAN AIR ACT TO INCLUDE CLOSELY RELATED INFORMATION THAT IS RELEVANT TO THE AGENCY'S OBLIGATIONS UNDER SECTION 115 OF THE CLEAN AIR ACT".

We learned at the outset of these hearings that this request has been rejected.

Even given our problem with the terms of reference our evidence is relevant to the impact on New York and Pennsylvania. We have directed our testimony towards the issues on which comment is invited in the Federal Register Notice. This includes questions of whether the sources identified result in unacceptable interstate impact, whether the effects of these sources should be considered in the aggregate, whether long-range models are available and how the models can be used. As much as possible our evidence deals with the impact of sulfur dioxide, particulate and visibility on the states of New York and Pennsylvania.

For several decades, Ontario has been well aware of damage to vegetation and surface waters caused by SO_2 in the area around Sudbury. High ambient SO_2 concentrations caused by non-ferrous smelters have destroyed forests. The acidifying effect of SO_2 as it reacts directly with surface waters or indirectly with moisture in the air and is then deposited, has altered surface water chemistry and led to the destruction of fish populations in numerous lakes in the area. The environmental damage has been well studied and the case is well-known as an example of SO_2 damage.

NON-FERROUS SMELTERS HAVE OPERATED IN SUDBURY SINCE THE LATE 1880'S. ONE COMPANY IN THE AREA, INCO LIMITED, IS THE LARGEST POINT SOURCE OF SO_2 IN THE WORLD.

IN THE 1960'S, ONTARIO GOVERNMENT CONTROL ORDERS REQUIRED THE REDUCTION OF SO_2 EMISSIONS AND THE CONSTRUCTION OF THE WORLD'S HIGHEST STACK TO DISPERSE THE REMAINING SO_2. TODAY SO_2 EMISSIONS HAVE BEEN REDUCED BY SOME 60% AND PLANT EMISSIONS ARE FURTHER CONTROLLED AS A FUNCTION OF WEATHER CONDITIONS.

IN SUDBURY, AS IN OTHER PARTS OF NORTH AMERICA, HIGH STACKS FOR DISPERSION PURPOSES WERE AN ACCEPTABLE APPROACH TO ADDRESS LOCAL AMBIENT AIR NEEDS.

IN THE U.S., MORE THAN 175 SMOKE STACKS EXCEEDING 500 FEET HAVE BEEN CONSTRUCTED SINCE 1970. ALL BUT 8 ARE AT POWER PLANTS WITH EMISSIONS WHICH CAN CONTRIBUTE TO VISIBILITY DETERIORATION AND ACID DEPOSITION IN DISTANT AREAS (EPA, 1979).

IN 1975, ONTARIO BEGAN A DETAILED STUDY OF LAKES IN THE DORSET AREA WITH THE OBJECTIVE OF DETERMINING THE EFFECTS OF COTTAGE DEVELOPMENT ON WATER QUALITY. WITHIN THE FIRST YEAR OF THE STUDY IT WAS LEARNED THAT ATMOSPHERIC ACID LOADINGS TO THE LAKES WERE ELEVATED AND THAT SURFACE WATER QUALITY WAS BEING AFFECTED.

THE AREA IS REMOTE FROM SOURCES OF SO_2 AND LIES IN PRECAMBRIAN SHIELD BEDROCK. THE BEDROCK AND THIN SOILS AND SURFACE WATERS HAVE MUCH LESS CAPACITY TO NEUTRALIZE ACIDS THAN THE ALKALINE SOILS OF SOUTHERN ONTARIO. THE GEOLOGY OF THE AREA IS SIMILAR TO THE ADIRONDACK MOUNTAINS IN NEW YORK WHERE LAKES HAVE BEEN ACIDIFIED AND FISH POPULATIONS LOST IN THE PAST FEW DECADES.

THE POSSIBILITY IMMEDIATELY AROSE THAT THE SUDBURY EMISSIONS OF SO_2 WERE SIMPLY BEING DEPOSITED FURTHER AFIELD. DATA WHICH WILL BE DISCUSSED IN DETAIL LATER RESOLVED THAT PARTICULAR ISSUE.

PRECIPITATION DATA HAS INDICATED THAT 70-85% OF THE SULFUR BEING DEPOSITED IN THE DORSET AREA ORIGINATED IN THE SOUTH AND SOUTHWEST.

IT WAS THEREFORE FULLY ESTABLISHED THAT THE LONG-RANGE TRANSPORT AND DEPOSITION OF POLLUTANTS AND RESULTING SURFACE WATER QUALITY EFFECTS ARE WELL-DOCUMENTED IN EUROPE AND ARE A REALITY IN ONTARIO.

IN LIGHT OF THESE REALIZATIONS WE BECAME AWARE OF THE NEED TO LOOK BEYOND OUR OWN BOUNDARY TO DEVELOP THE NECESSARY COMPREHENSIVE APPROACH TO THIS PROBLEM. IN CO-OPERATION WITH THE FEDERAL GOVERNMENT WE DIRECTED CONSIDERABLE RESOURCES INTO WORKING ON AN INTERNATIONAL SOLUTION.

THE FIRST CONSTRUCTIVE STEP WAS THE MEMORANDUM OF INTENT ON TRANSBOUNDARY AIR POLLUTION SIGNED ON AUGUST 5, 1980, WHICH COMMITTED BOTH NATIONS TO RESIST EMISSION INCREASES AND TO BRING ABOUT REDUCTIONS WHERE POSSIBLE, PENDING CONCLUSION OF A COMPREHENSIVE INTERNATIONAL AGREEMENT.

UNDER THIS DOCUMENT, BOTH THE U.S. AND CANADA UNDERTOOK TO TAKE CERTAIN INTERIM ACTIONS. THESE INCLUDED THE DEVELOPMENT OF AIR POLLUTION CONTROL STRATEGIES AND THE VIGOROUS ENFORCEMENT OF EXISTING LAWS AND REGULATIONS "IN A WAY WHICH IS RESPONSIVE TO THE PROBLEMS OF TRANSBOUNDARY AIR POLLUTION".

INTERIM REPORTS HAVE BEEN PUBLISHED AND THE IMPACT DOCUMENTS SHOW THERE IS NO LONGER A QUESTION OF "JUST HOLDING THE LINE". CLEARLY, SULFUR DEPOSITION MUST BE REDUCED IF ECOSYSTEMS ARE TO BE PROTECTED IN THE FUTURE.

THERE ARE MANY UNRESOLVED PROBLEMS WITH RESPECT TO THE PHENOMENON OF LONG-RANGE TRANSPORT OF ATMOSPHERIC POLLUTANTS AND ONTARIO IS CONTRIBUTING HEAVILY TO INTERNATIONAL RESEARCH EFFORTS TO RESOLVE THESE PROBLEMS.

I CANNOT ACCEPT, HOWEVER, ANY ASSERTION THAT WE DO NOT HAVE ENOUGH EVIDENCE TODAY FOR GOVERNMENT TO TAKE FURTHER STEPS TO ABATE SULFUR DIOXIDE EMISSIONS.

THE FACT IS, THAT WE ALREADY HAVE SUFFICIENT SCIENTIFIC EVIDENCE OF THE DANGER OF LONG-RANGE TRANSPORT AND ITS ENVIRONMENTAL CONSEQUENCES AND WE ARE PAINFULLY AWARE OF THE LIMITED TIME-FRAME IN WHICH ACTION MUST BE TAKEN.

I AM REFERRING PARTICULARLY HERE TO THE LAKES AND AQUATIC LIFE IN THOSE AREAS OF CANADA AND THE U.S. WHICH ARE PARTICULARLY SENSITIVE TO THE DEPOSITION OR FALLOUT OF THESE POLLUTANTS.

AT SOME POINT IT BECOMES NECESSARY FOR GOVERNMENTS TO TAKE ACTION ON THE BEST EVIDENCE AVAILABLE WITHOUT WAITING UNTIL ALL OF THESE SCIENTIFIC QUESTIONS HAVE BEEN ANSWERED TO THE SATISFACTION OF EVERYONE. LET ME TAKE AN EXAMPLE: MORE THAN A DECADE AGO IT BECAME WIDELY RECOGNIZED THAT PHOSPHORUS LOADINGS WERE CAUSING SEVERE STRESSES IN THE GREAT LAKES. HAD A DECISION BEEN TAKEN TO POSTPONE CORRECTIVE ACTION UNTIL ALL OF THE SCIENTIFIC QUESTIONS HAD BEEN ANSWERED, WE WOULD STILL BE WAITING TODAY.

IF, FOR EXAMPLE, REGULATORY AGENCIES HAD INSISTED ON ESTABLISHING WITH CERTAINTY THE RELATIONSHIP BETWEEN THE OBSERVED EFFECTS AND EACH POTENTIAL SOURCE, THOSE LAKES WOULD BE SLOWLY STRANGLING.

INSTEAD WE HAVE SEEN A STEADY IMPROVEMENT AND RECOVERY IN THOSE LAKES, DIRECTLY ATTRIBUTABLE TO THE CONTROL MEASURES THAT WERE IMPLEMENTED.

MY VIEW IS SHARED BY THE JOINT CHAIRMEN OF THE CANADA/ U.S. CO-ORDINATING COMMITTEE AND I QUOTE FROM THEIR LETTER OF TRANSMITTAL FOR THE FEBRUARY, 1981 INTERIM REPORT, "FURTHER RESEARCH MUST OBVIOUSLY CONTINUE BUT SOLUTIONS SHOULD BE SOUGHT IN THE NEAR TERM".

THE SIGNIFICANCE OF ENFORCEMENT IS UNDERLINED BY EPA'S OHIO RIVER BASIN ENVIRONMENT STUDY (ORBES) IN WHICH IT IS STATED ON PAGE 13 THAT TOTAL SULFUR DIOXIDE EMISSIONS FROM THE STATES STUDIED COULD BE REDUCED BY 1/3 BY 1985 BY REQUIRING COMPLIANCE WITH CURRENT SIP SO_2 EMISSION LIMITS.

THE REPORT ALSO SHOWS (FIGURE ES-4, PG. 11) THAT IF THE SIP STANDARDS ARE NOT COMPLIED WITH AND NO COMPLIANCE SCHEDULE IS ENFORCED, EMISSIONS WILL CONTINUE TO RISE UNTIL 1987. BY THE END OF THE CENTRUY THEY WOULD ONLY BE SLIGHTLY BELOW CURRENT LEVELS. EVEN THIS ASSUMES THAT THE PLANTS WILL BE RETIRED AFTER 35 YEARS OF USE. IF THIS DOES NOT OCCUR, THE EMISSION LINE WOULD CONTINUE TO MOVE STEADILY UPWARD.

I WANT TO DEAL NEXT WITH THE MEASURES WE ARE TAKING IN ONTARIO WHICH ARE IN THE SPIRIT OF INTERIM COMMITMENTS UNDER THE MEMORANDUM AND IN LINE WITH THE NEED TO TAKE STEPS NOW.

I AM GOING TO RETURN TO THE CASE OF INCO AT SUDBURY. ON SEPTEMBER 2, 1980, A NEW SET OF CONTROLS WAS ENACTED UNDER A STATUTORY POWER ENABLING THE LIEUTENANT GOVERNOR IN COUNCIL TO MAKE REGULATIONS REGULATING THE EMISSION OF CONTAMINANTS "INTO THE NATURAL ENVIRONMENT FROM ANY SOURCE OF CONTAMINANTS OR ANY CLASS THEREOF".

A REGULATION IN OUR JURISDICTION IS SUBORDINATE LEGISLATION HAVING THE SAME EFFECT AS A STATUTE. IT IS NOT SUBJECT TO ANY STATUTORY APPEAL. IF IT IS WITHIN THE STATUTORY POWER AND MADE IN GOOD FAITH, IT IS ALMOST UNASSAILABLE IN THE COURTS.

I OUTLINE THE NATURE OF THIS ACTION, NOT IN AN ATTEMPT TO PERSUADE YOU TO FOLLOW OUR LAWS AND PROCEDURES, BUT RATHER TO UNDERLINE THE EXTREME SERIOUSNESS WITH WHICH THIS ISSUE IS REGARDED BY THE ONTARIO PUBLIC.

UNDER THE REGULATIONS, INCO IS REQUIRED TO REDUCE ITS EMISSIONS BY JANUARY 1, 1983, TO A LEVEL WHICH REPRESENTS A 70% REDUCTION FROM THE LATE 1960's. THE EMISSIONS ARE TO BE KEPT AT THAT LEVEL REGARDLESS OF PRODUCTION. THIS CAN ONLY BE ACCOMPLISHED BY INNOVATIVE CHANGES IN THE METALLURGICAL PROCESS AND PRELIMINARY WORK IS ALREADY UNDERWAY TO ACCOMPLISH THESE CHANGES.

THE INCO REGULATION IS AN INTERIM MEASURE. A CANADA/ ONTARIO TASK FORCE WILL REPORT THIS AUTUMN ON OPTIONS TO REDUCE INCO'S EMISSIONS TO THE LOWEST POSSIBLE LEVEL.

THE SECOND LARGEST SOURCE OF ACID CAUSING POLLUTANTS IN ONTARIO IS ONTARIO HYDRO'S THERMAL PLANTS. ON FEBRUARY 17, 1981, A REGULATION WAS FILED WHICH PLACES A CEILING ON FUTURE EMISSIONS FROM THE COAL-FIRED STATIONS OPERATED BY ONTARIO HYDRO. IT WILL REQUIRE A 43% REDUCTION FROM CURRENT LEVELS BY THE YEAR 1990. FROM THAT DATE SO_2 EMISSIONS CANNOT EXCEED A CEILING OF 260,000 METRIC TONS NOTWITHSTANDING INCREASES IN ELECTRICAL OUTPUT FROM THE SYSTEM.

HYDRO WAS ALSO ADVISED THAT FURTHER RESTRICTIONS MAY BE FORTHCOMING AS A RESULT OF THE FUTURE OF A CANADA/U.S. AGREEMENT ON TRANSBOUNDARY POLLUTION.

FURTHER, AT THE REQUEST OF THE GOVERNMENT, ONTARIO HYDRO IS INVESTIGATING THE IMPLEMENTATION OF THE LEAST EMISSION DISPATCH SYSTEM (L.E.D.S.) WHICH WOULD LEAD TO FURTHER SIGNIFICANT REDUCTIONS FROM EXISTING PLANTS. UNDER THIS SYSTEM THE UTILITY GENERATES POWER FROM ITS "CLEANEST" PLANT FIRST AND ITS "DIRTIEST" PLANT LAST.

IT IS IMPORTANT TO NOTE THAT THESE CONTROL MEASURES ON INCO AND ONTARIO HYDRO TAKEN IN ADVANCE OF AN INTERNATIONAL AGREEMENT AND TAKEN TO DEAL WITH LONG-RANGE TRANSPORT AND ACID RAIN, ARE ADDRESSED TO LIMITING LOADINGS OF SO_2. THIS QUESTION OF LOADINGS WAS ADDRESSED IN THE REPORT OF THE NATIONAL COMMISSION ON AIR QUALITY "TO BREATHE CLEAN AIR" ISSUED MARCH, 1981. THE REPORT STATES:

I QUOTE:

"THE NATIONAL AMBIENT AIR QUALITY STANDARDS ARE THE CORNERSTONE OF THE CLEAN AIR ACT PROGRAM FOR THE CONTROL OF POLLUTION FROM EXISTING STATIONARY SOURCES. HOWEVER, THE KEY FACTOR ASSOCIATED WITH THE MOST SERIOUS ENVIRONMENTAL EFFECTS OF A PROBLEM SUCH AS ACID DEPOSITION IS NOT AMBIENT POLLUTANT CONCENTRATION BUT RATHER TOTAL POLLUTANT LOADING, WHICH IS ONLY INDIRECTLY LINKED TO AMBIENT CONCENTRATIONS (ELI, 1981). LARGE QUANTITIES OF POLLUTION CAN BE RELEASED WITHOUT VIOLATING AMBIENT STANDARDS IN AN AREA IF THE EMISSIONS ARE SUFFICIENTLY DISPERSED. THEREFORE, IT IS POSSIBLE FOR A STATE TO INSTITUTE A CONTROL PROGRAM SUFFICIENTLY STRINGENT TO PROTECT LOCAL HEALTH, AS DEFINED BY PRIMARY NATIONAL AMBIENT AIR QUALITY STANDARDS, BUT THAT STILL PERMITS POLLUTANT EMISSIONS THAT CAN CAUSE SERIOUS ACID DEPOSITION PROBLEMS IN DISTANT DOWNWIND REGIONS." (P.3.9-2).

IN LIGHT OF THIS, WE WOULD URGE THAT YOU PURSUE POLICIES CONSISTENT WITH THE DECLARED INTENTIONS OF OUR TWO COUNTRIES IN THE MEMORANDUM OF INTENT, TO VIGOROUSLY ENFORCE CURRENT REGULATIONS, DISCOURAGE RELAXATION OF THESE REGULATIONS AND TO ACHIEVE ADDITIONAL REDUCTIONS WHEREVER POSSIBLE.

LET ME NOW ADDRESS THE SPIRIT IN WHICH THE EVIDENCE SHOULD BE APPROACHED. IT IS IMPORTANT TO TAKE INTO ACCOUNT ALL THE EVIDENCE AVAILABLE TO YOU, GIVING EACH PIECE ITS APPROPRIATE WEIGHT.

YOU SHOULD NOT LOOK AT ANY PIECE OF EVIDENCE IN ISOLATION, BUT IN THE CONTEXT OF WHAT ALL THE EVIDENCE IS TELLING YOU. THE MAGNITUDE AND DISTRIBUTION OF SOURCES, METEOROLOGY, BACK TRAJECTORY ANALYSES, SATELLITE OBSERVATIONS, SPECIFIC LONG-RANGE TRANSPORT OF POLLUTION EPISODES, AND MODELLING ACTIVITIES WHICH PULL ALL THIS DIVERSE EVIDENCE TOGETHER.

ALL OF THIS IS REQUIRED TO UNDERSTAND AND COMBAT THE PHENOMENA OF ACID RAIN. WITHOUT THIS TOTAL APPROACH WE SEVERELY CRIPPLE OUR COLLECTIVE ABILITY TO PROTECT OUR SENSITIVE ENVIRONMENTS.

TESTIMONY OF BRUCE J. TERRIS
ON BEHALF OF THE PROVINCE OF
ONTARIO, CANADA AT THE EPA
SECTION 126 HEARING, JUNE 19, 1981

Good afternoon. My name is Bruce J. Terris. I am an attorney with the law firm of Terris & Sunderland in Washington, D.C. I am here this afternoon representing the Province of Ontario, Canada.

Mr. Scott, Ontario's Deputy Minister of the Environment, has already spoken of Ontario's interest in these proceedings. The emissions sources which are the subject of these hearings not only threaten New York's and Pennsylvania's efforts to comply with the Clean Air Act. These sources also contribute significantly to the formation of acid deposition that is already severely harming the environment of Ontario. Any emissions reductions that result from these proceedings will benefit the Province of Ontario. Thus, the Province has an extremely important stake in the outcome of these proceedings. We therefore appreciate the opportunity to appear before you this afternoon to discuss with you the proper approach to remedying the serious problems which Canada and the United States face relating to the long-range transport of pollutants.

My first point concerns the status of these hearings under Section 126. Two sections of the Clean Air Act are relevant in ascertaining the procedures which the agency should follow when addressing interstate pollution.

Section 126(b) provides that "within 60 days after receipt of any petition under this subsection and after public hearing, the Administrator shall make such a finding [of interstate air pollution] or deny the petition."

Section 307(d)(1)(M) provides that Section 307 rulemaking procedures apply to "action of the Administrator under section 7426 of this title (relating to interstate pollution abatement) * * *." Under Section 307(d)(3), a rulemaking begins with the publication in the Federal Register of a notice of proposed rulemaking which "shall be accompanied by a statement of its basis and purpose * * *." The contents of the statement of basis and purpose are specified by the statute as follows (ibid.):

> The statement of basis and purpose shall include a summary of ---
>
> (A) the factual data on which the proposed rule is based;
>
> (B) the methodology used in obtaining the data and in analyzing the data; and
>
> (C) the major legal interpretations and policy considerations underlying the proposed rule.
>
> * * *

> All data, information and documents referred to in this paragraph on which the proposed rule relies shall be included in the docket on the date of publication of the proposed rule.

EPA's May 1, 1981, announcement of these hearings (46 Fed. Reg. 24602) clearly does not satisfy the requirements of a notice of proposed rulemaking under Section 307. The rulemaking will therefore not begin until after these hearings when EPA announces its proposed determination and satisfies the burden of production imposed by Section 307(d)(3) by placing relevant evidence, and EPA's analysis of that evidence, on the rulemaking record for scrutiny.

If EPA tentatively decides to grant New York's and Pennyslvania's petitions, then I think it is clear that the agency must publish a notice of proposed rulemaking complying with the requirements of Section 307(d)(3). After that notice is published, and after EPA has satisfied the requirement of producing information, then Section 307(d)(5) will require the agency to give interested persons another opportunity to submit comments, orally and in writing.

We note that this second set of comments is not a duplication of the comment period the agency is now conducting. The crucial difference is that the second stage of these proceedings centers on EPA's proposed determination and the evidence the agency has produced and placed on the rulemaking

record. At this earlier stage, we are addressing only the threshold question of whether EPA's proposed determination should be affirmative or negative, based on the evidence that has been submitted by the two petitioning states and any other persons who choose to present evidence.

If EPA decides to deny New York's and Pennsylvania's petitions, the agency still must comply with Section 307's procedural requirements before it can become final. Section 307 applies to "action of the Administrator" under Section 126 (Section 307(d)(1)(M)) (emphasis added). The use of the generic term "action" rather than the word "finding" -- the term used by Section 126 to describe an affirmative decision -- indicates that Section 307 procedures are intended to apply whether the agency's initial decision is affirmative or negative.

This reading of Sections 126 and 307 is consistent with the significance that the EPA should attach to the filing of a Section 126 petition. These are not ordinary rulemaking petitions. Government agencies must be free to deny most rulemaking petitions without elaborate procedures in order to enable the agency to dispose of frivolous petitions. Such an escape hatch is unnecessary in the case of Section 126(b)

because that section already has the built-in safeguard that it must be invoked by a state or political subdivision.

Moreover, rulemaking petitions in other contexts often ask the agency to make a discretionary decision about where to employ its limited resources. An agency should not be required to expend significant resources building a record justifying denial of a rulemaking petition if the reason for the denial is that the agency believes that the issues raised are relatively unimportant. That rationale, however, does not apply to a Section 126 petition. By enacting Section 126, and the corresponding provision of Section 110(a)(2)(E), Congress has made clear that EPA has the duty to deal with the issue of interstate impacts. Indeed, one can hardly imagine a more appropriate issue for federal intervention than interstate and international transport of pollutants.

Based on this analysis of Section 126, several issues fall into place. The purpose of this week's hearings becomes more clear. These initial proceedings should be viewed as aiding the agency in focusing the issues, gathering information, and making a preliminary determination on the merits of the petitions. This limited role is consistent with the short time period, 60 days, provided by Section 126(b) for the agency to respond to a petition under that section. This

initial stage serves a function similar to comment on an advance notice of proposed rulemaking, frequently referred to as an ANPR. The goal is to help the agency shape its proposed determination in a manner that allows the subsequent rulemaking proceeding to be tightly focused on the central, relevant issues. By this method, a better record should be produced, leading to a more informed, and more expeditious, final determination.

Moreover, the sequence of proceedings I have set forth helps to resolve the issues raised by Roger Strelow, counsel for many of the utilities affected by these petitions, in his letters of April 14 and June 8, 1981, to EPA. Mr. Strelow is concerned that the record as it currently stands does not allow for full analysis of the issues raised by the petitions. We submit the solution lies in Section 307. Once the agency has complied with the notice of proposed rulemaking requirements of Section 307(d)(3), all interested persons, including affected utilities, will have a full opportunity to comment meaningfully.

Mr. Strelow suggests that these proceedings should be bifurcated into two stages: first, a proceeding devoted to determining whether unlawful interstate impacts are occurring; and second, a proceeding dealing with questions of

remedy, if that proves necessary. We do not think that EPA is legally required to conduct a two-step procedure. It could hold a unified Section 307 proceeding on both interstate impacts and remedies. We do believe, however, that EPA has the discretionary authority to hold separate hearings on remedies and that it may well be appropriate to do so in this case.

In any event, the issue of remedies is not central to the issues before you in the present hearing. The issue today is whether an interstate air pollution problem exists which is covered by Section 126. As I will discuss later, we believe that the evidence in this proceeding clearly demonstrates that such a problem under Section 126 does exist and therefore further proceedings under Section 307 are required.

Second, I would like to address EPA's basic responsibility in this proceeding. Congress has been attempting to get EPA to remedy the problem of interstate pollution since 1970. In 1977, Congress concluded that EPA had so construed the Act that there was no effective mechanism to prevent interstate pollution. It therefore adopted Section 126 and made clear its intent to ensure that EPA take effective action.

EPA therefore has been emphatically told by Congress to make Section 126 work. Some speakers have said that Section 126 is a bad mechanism for solving the interstate pollution problem. They say that Section 126 will not be easy to implement. That is undoubtedly true because transboundary pollution raises difficult problems. But the fact is that Congress has plainly told EPA in 1970 and, more emphatically, in 1977, that interstate pollution problems are to be resolved and that Section 126 is to be a mechanism to resolve them. Thus, EPA does not have the choice to allege lack of scientific certainty, to note the procedural or remedial difficulties, or to raise other problems as reasons to throw up its hands. Instead, Congress imposed on EPA the duty, we submit, the non-discretionary duty, to construe Section 126 so that it will work.

Third, we strongly quarrel with Mr. Strelow as to where he suggests placing the burden in this proceeding. The petitioning state agencies have the initial responsibility to trigger Section 126(b). The importance of EPA's proposed determination creates strong incentives for the petitioners to submit as much evidence as feasible to support their positions. Since if EPA is to rely on that information, it needs to know how the information was obtained, petitioners have a strong incentive to submit full documentation for their claims.

Nonetheless, EPA bears the responsibility to gather information relevant to these petitions, not to sit as a passive

judge deciding whether the petitioners have met their burden of proof. It is not an umpire calling balls and strikes. Thus, in Office of Communication of United Church of Christ v. Federal Communications Commission, 425 F.2d 543, 548 (D.C. Cir. 1969), then Judge Burger held that "[t]he Commission * * * ha[s] an affirmative duty to assist in the development of a meaningful record which can serve as the basis for the evaluation of the licensee's performance of his duty * * *."

EPA has been charged with the responsibility to ensure that the Clean Air Act is fully and effectively carried out. EPA, not Pennsylvania, not New York, not Ontario, has this overriding responsibility. And this responsibility to carry out the Act clearly includes the prevention of interstate pollution.

EPA has previously argued, both in Federal Register notices relating to SIP relaxation and a court brief, that a Section 126 proceeding, not review of a SIP revision under Section 110, is the proper forum for considering aggregate pollution emissions. See 46 Fed. Reg. 24560 (May 1, 1981) (SIP revision for Consumer Power's Cobb plant); 46 Fed. Reg. 24946 (May 4, 1981) (SIP revision for Toledo Edison's Bayshore plant); Brief for Respondents, Pennsylvania v. U.S. Environmental Protection Agency, No. 79-1026 (C.A. 3) pages 34-35. That argument is totally indefensible if the EPA uses its decision

to deal with these issues under Section 126 as a method to shift the ultimate burden of proof to the receptor states. Section 126 is merely an alternate means of placing the subject of interstate impact in issue. The criteria for review are set forth in Section 110(a)(2)(E). EPA retains the ultimate responsibility to ensure that the interstate impacts prohibited by that section are not occurring. This is true whether the interstate impacts are examined in the context of review of a SIP or of a SIP revision or in response to a petition under Section 126. This is particularly true where EPA has failed, as here, to examine long-range impacts in its initial review of the underlying SIPs.

Fourth, the opponents to these petitions argue that there is insufficient evidence concerning long-range transport to support Pennsylvania's and New York's position. We submit that the evidence presented in this proceeding by New York and Pennsylvania and the evidence which Ontario will present demonstrates conclusively the serious transboundary pollution problem affecting the northeastern United States, as well as Canada. Indeed, we submit that everyone, EPA, the midwestern states and even industry, know that there is a significant transboundary air pollution problem affecting the northeast and Canada. The dispute is about the details, yes, important details, but still details. All the fighting over models , over trajectory analysis, over the comparative contribution of local and

distant sources, and all the other disputes should not obscure the fact that a serious transboundary problem exists and must be faced.

Fifth, we strongly reject the notion that lack of sufficient information requires that no action be taken until elaborate research programs are completed. Congress surely knew that there could be no scientific certainty concerning interstate pollution problems when it passed Section 126. It still wanted EPA to act.

Scientific certainty is always the argument for those who want to maintain the status quo. It is always the argument when government agencies are reluctant to act. But there is no scientific certainty for almost any of the requirements of the Clean Air Act. Moreover, there is no greater scientific certainty for most of the other actions taken by federal or state or local governments in many fields. The Court of Appeals for the District of Columbia Circuit has said it far better than I could in upholding an EPA action under the Clean Air Act in Ethyl Corp. v. Environmental Protection Agency, 541 F.2d 1, 24-25, 28-29 (D.C. Cir. 1976), certiorari denied, 96 S. Ct. 2662 (1976):

> Questions involving the environment are particularly prone to uncertainty. Technological man has altered his environment in ways never before experienced or anticipated. * * * [T]he statutes -- and common sense -- demand regulatory action to prevent

> harm, even if the regulator is less than certain that harm is otherwise inevitable.
>
> * * *
>
> Where a statute is precautionary in nature, the evidence difficult to come by, uncertain, or conflicting because it is on the frontiers of scientific knowledge, the regulations designed to protect the public health, and the decision that of an expert administrator, we will not demand rigorous step-by-step proof of cause and effect. * * * The Administrator may apply his expertise to draw conclusions from suspected, but not completely substantiated, relationships between facts, from trends among facts, from theoretical projects from imperfect data, from probative preliminary data not yet certifiable as "fact," and the like.

In short, it is the duty of EPA to carry out the statute using the best information available.

Sixth, it has been suggested that Section 126 is violated only if the pollutants transported from out-of-state sources make it impossible for the receptor state to achieve attainment with the national air quality standards. However, if this were the test, Section 126 would have no meaning whatsoever. It is always possible for a state to achieve attainment by limiting its own sources except for the virtually impossible situation where out-of-state sources will alone cause NAAQS violations in another state. In other words, if the possibility of submitting an approvable plan were the test, Ohio could send into Pennsylvania enough pollution to consume

90% of allowable emissions. If Pennsylvania can reduce their emissions to 10% of the national standard -- which, of course, is possible by declaring the entire state a wilderness area -- then Section 126 has not been violated. I submit that reading of the statute is ridiculous.

Indeed, it is not only possible for a state to meet the national air quality standards by controlling its own emissions, it is required to do so. Thus, all states have either attained the standards already or must have a plan to do so. If any state which either has attained the standards or has a plan to do so cannot invoke Section 126, then the only states which could do so would be those in violation of federal law. It is incredible to believe that Congress could have intended any such result.

The absurdity of the argument is demonstrated by Mr. Strelow's testimony. He argues that New York cannot invoke Section 126 because he claims, albeit erroneously, that it has met the national standards. Yet, at the same time, he argues that it cannot invoke Section 126 because it has not done a good enough job itself in controlling its own pollution sources. It is obvious that Mr. Strelow's arguments would never allow anyone to invoke Section 126.

We submit that the language and legislative history of Section 126 make clear that Section 126 applies if the source state significantly interferes with the attainment or maintenance of the national standards. We submit that this test is plainly satisfied when significant amounts of pollution are transported into the recipient state and, as a result, the recipient state is forced to impose significantly more stringent requirement on its pollution sources than the source state. In these circumstances, we submit that Section 126 has been violated even if there is no current violation of a national standard.

Seventh, EPA has asked whether it should be considering the cumulative impacts of sources or each source alone. EPA has already answered its own question in its brief filed only three months ago in Pennsylvania v. EPA in the Third Circuit (Docket No. 79-1025, p. 35):

> As required by Section 126, EPA intends to hold a hearing in the near future to consider the issues raised in Pennsylvania's petition. That section 126 proceeding will be the appropriate forum for evaluating Pennsylvania's claims regarding cumulative out-of-state source impacts. * * * (E)missions impacts due to any identified out-of-state sources can be considered in a Section 126 proceeding. (emphasis added)

EPA's position that Section 126 is an appropriate forum to consider cumulative out-of-state sources is clearly correct. Section 126 would be effectively destroyed if each source is to be considered alone. Rarely, if ever, will a single source seriously interfere with attainment of national standards in another state. As I have emphasized, EPA's duty is to make

Section 126 work, not to leave it an empty shell.

Finally, while you have determined not to broaden the present hearing to consider international pollution under Section 115, I wish to restate Ontario's position that, when the time comes for EPA to consider the remedies for transboundary pollution, it is essential that interstate pollution in the northeastern United States and international pollution in southeastern Canada be considered together. I will not spend time today arguing that EPA has a responsibility under Section 115 to go forward with proceedings to abate long-range transport of pollutants that are endangering Ontario and other parts of Canada. We have set forth our views of EPA's obligations under Section 115, particularly in light of its January 16, 1981, determination, in our written request of May 28, 1981, to expand the scope of these hearings. We intend to continue to urge EPA's obligation to proceed to carry out its clear responsibilities under Section 115 in every appropriate forum.

In any event, it is obvious that the problems of interstate and international air pollution in the northeastern United States and Southeastern Canada are interrelated. I would therefore like to take a look down the road at the process which EPA should follow to devise a remedy under Section 126, compare it to the process appropriate for Section 115, and tentatively suggest how the two should be coordinated.

Section 126(c) provides, in effect, for a federal SIP revision. If the Section 126(b) finding has been made, affected sources must cease operations in three months, unless the Administrator provides for no more than a three-year phase-in of the necessary emissions reductions. There is no provision requiring any action by the state in which the source is located.

Under Section 115, a finding of international air pollution "shall be deemed to be a finding under Section 7410 (a)(2)(H)(ii) * * * which requires a plan revision with respect to so much of the applicable implementation plan as is inadequate to prevent or eliminate the endangerment * * *." In other words, a Section 115 finding requires the affected states to develop SIP revisions.

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To return again to Section 126, if a petition filed under that section affects one or a few sources, it may make sense to have EPA establish the compliance schedule.

But, in the case of petitions that affect numerous sources, I can understand reluctance on the part of EPA to take on the task of creating new emissions limitations for so many sources. Furthermore, to the extent possible, it would be most consistent with the spirit of the Clean Air Act and its division of responsibilities between the federal government and the states to allow the states a major role in allocating reductions to the sources affected within their states.

By now, it should be clear how readily this scheme for implementing Section 126 can be integrated with the process outlined for Section 115. The procedural difference is that emissions reductions under Section 115 are to be adopted by the states as state SIP revisions whereas Section 126 appears to contemplate adoption of a federal compliance schedule. We submit that this is a distinction without a difference. As a practical matter, the source-by-source emissions reductions should be proposed by the states in the first instance, and they are subject to federal review in either case. EPA could make the symmetry complete by giving the states the option under Section 126 of adopting the reductions themselves through the SIP process and then, if the reductions are acceptable, declaring those reductions to constitute the schedule required by Section 126(c).

We do note, however, that there is a significant difference between Sections 126 and 115 as to the criteria for measuring the impacts in the receptor states. Under

Section 126, the criteria are the national ambient air quality standards, PSD increments and visibility. Under Section 115, the criteria are expressed in the general phrase "air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country." Thus, Section 115 encompasses pollutants, such as sulfates, and effects, such as acid rain, even though they are not subject to national air quality standards.

The reductions necessary to satisfy Section 126 may be more or less than the reductions necessary under Section 115. Nonetheless, the emissions, sources and states identified by New York and Pennsylvania are the same emissions, sources and states that are contributing to acid deposition in Ontario. It seems foolish to go through the time-consuming and difficult process of establishing emissions schedules necessary to satisfy one of these sections of the Clean Air Act and then have to repeat the whole process again to satisfy the requirements of the other. That is the kind of unnecessary regulatory duplication that we can all condemn.

We therefore urge that EPA deal concurrently in the subsequent stages of this proceeding with international and interstate long-range air pollution. We urge that it do so by publishing a notice of proposed rulemaking that complies with Section 307(d)(3) and invokes the authority of both Sections 126 and 115. The rulemaking should encom-

pass all major sources of SO_2 that EPA tentatively determines are contributing to long-range international and interstate pollution, including the formation of acid deposition affecting Canada.

In conclusion, based on the record of these Section 126 hearings and on the information otherwise available, we submit that EPA will be compelled to propose a finding that interstate air pollution is occurring in violation of Section 110(a)(2)(E) of the Clean Air Act. We also submit that EPA has already determined that Section 115 has been violated and that the agency has a mandatory duty to continue the efforts initiated on January 16, 1981, to implement that section. We therefore urge that you initiate pursuant to Section 307(d) a joint proceeding to consider in detail the international and interstate pollution involved and appropriate remedies for it.

A Brief Description Of How Ontario Dynamically Integrates Policy and Rule Making with Information Gathering in Regard To Transboundary Air Pollution

Historically, Environment Ontario and other North American jurisdictions have been dealing with contaminants as pollutants in their own right, concerned with their potential "localized" and "community" effects.

To aid in this activity, the Ontario Environment Ministry established a Province-wide Inventory of air contaminants in 1972, which includes sulphur dioxide. Concentrations of 30 known air-borne contaminants are measured by a monitoring network distributed throughout Ontario which consists of more than 1,400 air quality instruments, some of which are operated on a special study basis. This monitoring network was established to obtain comprehensive knowledge of the air quality in Ontario. The data has been related to emitting sources and, in association with air quality simulation models, has been used to develop control strategies for these sources when air quality criteria set by the Province were exceeded.

However, in dealing with the problem of total suspended particulates and the photochemical product such as ozone, the evidence indicated that a large contribution was attributable to out-of-the province sources. More recently, acidic precipitation studies indicated that the precursors SO_2, sulphates and nitrates are due to sources which are in part

very distant from the sensitive receptor lakes.

The severity of this problem of long range transport in Ontario became apparent when we began to analyse the results from several special studies, in particular, the Sudbury Environmental and Lakeshore Capacity Studies. Both of these geographically intensive programs measured atmospheric pollutants and quantified the proportion which as a consequence of various physical and chemical means ultimately end up in sensitive terrestrial and aquatic ecosystems. As subsequent speakers will outline in detail, much has been learned from these studies about the ultimate fate of emissions of oxides of sulphur and particulates as well as other pollutants on a continental basis. In particular, these studies indicated that when using contemporary monitoring and analytical techniques, the secondary or evolutionary pollutants associated with primary emissions of particulates and SO_2 were being deposited in large measure by the rain falling over large portions of the Province. Furthermore, this polluted rain was and is seriously affecting Ontario's very sensitive environment.

In response to the seriousness of this situation and recognizing its similarity with the Scandina vian problem, the Ontario Government initiated a major long range transport of atmospheric pollutants or "acidic precipitation" program in 1979. Currently this program has a budget in excess of six million dollars per year which is of the order of $1.00 per

capita per year.

The major elements of this effort include the following, undertaken in parallel:

1. a scientific LRTAP/ACID Rain assessment program;
2. socio-economic initiatives;
3. control technology investigations;
4. information dissemination and public education program;
5. policy evaluation, recommendation and implementation.

The scientific program is broken down into the following specific components.

a) Cooperative international programs such as DOAPS (Detroit/Ontario Air Pollution Study), OSCAR (Oxidation and Scavenging Characteristics of April Rains), the Quetico Park initiative, and PEPE (Prolonged Elevated Pollution Episodes). The common objective of these studies is to track and quantify the deposition of transboundary pollutants from source to receptor;

b) detailed atmospheric chemistry studies, in particular the Nanticoke and Sudbury area plume washout studies;

c) wet and dry deposition monitoring networks on a provincial scale. Every effort has been made to integrate these with Canadian and U.S. networks;

d) investigative studies of both the aquatic and terrestrial effects of the long range transport of

air pollutants;

e) development and calibration of atmospheric transport models, which tie together all the information generated by the previously mentioned four points.

The socio-economic initiatives are investigating the various socio-economic consequences of various policy options and includes detailed investigation of appropriate methodologies as they relate to Ontario's recreational industry.

The Control technology investigations are exploring and evaluating the feasibility of different forms of abatement options including:

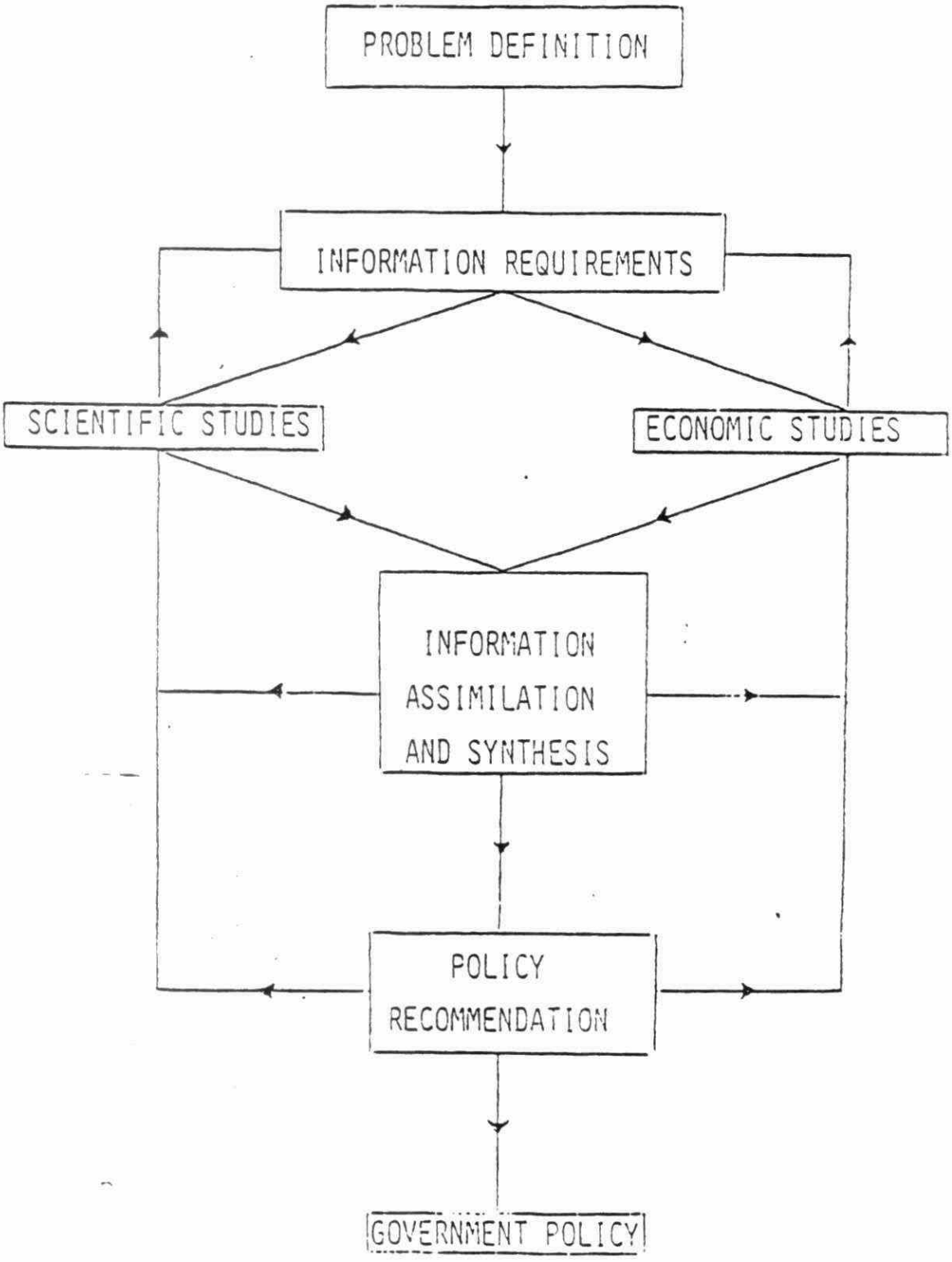
- Fluidized Bed Combustion
- Flue Gas Desulphurisation
- Limestone Injection Multistage Burner
- Use of Low Sulphur Coal
- Physical Coal Cleaning
- Oil Cleaning
- Hydrometallurgy
- Improved Pyrrhotite Separation
- Acid Production
- Improved Particulate Collecting Devices

At this point it is instructive to note that this activity is closely integrated with the source - receptor - effects modelling activity. It underlines the importance of modelling for expeditiously and rationally developing an effective abatement program.

The information dissemination and public information program has as its major objective the marshalling of public support for Ontario's initiatives to limit emissions within the Province of Ontario. In addition, Ontario has produced various media packages with which to convey its message to the North American audience including brochures, videotapes, fact sheets and a feature length film.

The integrated results of all these activities are being utilized by Ontario's regulatory arm (eg. the decision-makers such as Mr. G. Scott) so that decision making has and will continue to be undertaken in a logical, step-wise and expeditious manner to deal with this and other environmental problems. It is important to note that this "dynamic" activity which utilizes information from scientific and socio-economic programs is immediately responsive to any new information. The positive feedback aspect of this activity is systematically illustrated in (Figure One).

In summary, I have quickly outlined how Ontario came to recognize the problem of the long range transport of air pollutants, the studies that have been initiated as a result, and how this information is and will continue to be used to aid in policy decisions.


PROBLEM DEFINITION
INFORMATION REQUIREMENTS
SCIENTIFIC STUDIES
ECONOMIC STUDIES
INFORMATION ASSIMILATION AND SYNTHESIS
POLICY RECOMMENDATION
GOVERNMENT POLICY

Lou Shenfeld

CASE STUDIES OF TRANSBOUNDARY AIR POLLUTION: THE DEVELOPMENT OF EVIDENCE

DR. WALTER LYONS HAS ILLUSTRATED THE METEOROLOGICAL CONDITIONS THAT ARE CONDUCIVE TO THE LONG RANGE TRANSPORT OF AIR POLLUTANTS OVER EASTERN NORTH AMERICA. I AM GOING TO PRESENT QUANTITATIVE EVIDENCE OF THE RESULTS OF SUCH TRANSPORT AND THE IMPACT THAT THIS HAD ON PENNSYLVANIA, NEW YORK AND SOUTHERN ONTARIO.

THESE STUDIES HAVE BEEN USED BY OUR MINISTRY TO ASSESS THE RELATIVE IMPORTANCE OF ONTARIO'S SOURCES FOR THE PURPOSE OF REGULATION, AND I FEEL THAT THE RESULTS ALSO SUPPORT AND CONFIRM THE WORK OF DR. PARRY SAMSON REGARDING THE IMPACT OF TRANSBOUNDARY POLLUTION IMPACT IN NEW YORK AND PENNSYLVANIA.

ONE CASE THAT I WILL DESCRIBE IN DETAIL OCCURRED DURING THE PERIOD OF FEBRUARY 19 to 21, 1979. THE SERIES OF WEATHER MAPS FOR EARLY MORNING OF EACH OF THESE DAYS SHOWS THE LOCATION OF A HIGH PRESSURE AREA THAT WAS CENTRED SOUTH OF THE GREAT LAKES (FIG. 1) ON THE 19th, AND MOVED EASTWARD TO THE EAST COAST ON THE 20th. (FIG. 2). BEHIND THE HIGH WAS A PRONOUNCED SOUTHWESTERLY CIRCULATION. A LOW PRESSURE AREA MOVED INTO THE GREAT LAKES AREA ON THE 21st. (FIG. 3).

PRIOR TO THE 19th, SOUTHERN ONTARIO AND GREAT LAKES STATES WERE UNDER THE GRIP OF A PROLONGED COLD SPELL. THE COLD WEATHER WOULD CAUSE A HIGH ENERGY DEMAND FOR HEATING, RESULTING IN HIGHER THAN NORMAL EMISSIONS OF SULPHUR DIOXIDE AND PARTICULATE MATTER IN THE AREA.

AS SHOWN BY THE RADIOSONDE REPORTS FOR FLINT, MICHIGAN, (FIG. 4), THE AIRMASS OVER GREAT LAKES REGIONS ON THE 19th AND 20th WAS VERY STABLE WITH AN INTENSE INVERSION FORMING A STRONG LID ON THE UPWARD DISPERSION OF POLLUTANTS AT AN ALTITUDE OF APPROXIMATELY 500 METRES. THIS LIMITED MIXING HEIGHT PROVIDED THE CONDITIONS FOR THE EXTENDED TRANSPORT OF POLLUTANTS IN HIGH

CONCENTRATIONS INTO AND ACROSS ONTARIO.

AS SOUTHWESTERLY WINDS BACK OF THE HIGH PRESSURE AREA BECAME ESTABLISHED, SULPHUR DIOXIDE LEVELS AT THE MONITORING STATIONS INCREASED ACROSS THE ENTIRE MONITORING NETWORK. SEE FIG 5. THE CHANGE IN LEVELS CAN BE SEEN FROM THE 24-HOUR AVERAGE LEVELS LISTED FOR THE 19th, 20th AND 21st. (TABLES 1a AND 1b). IN ONTARIO THE LEVELS RANGED FROM NON-DETECTABLE TO A MAXIMUM AVERAGE OF 60 ppb ON THE 19th, WHILE ON THE 20th THE AVERAGE LEVELS WERE MUCH HIGHER, EXCEEDING 100 ppb AT A FEW LOCATIONS. ONTARIO'S CRITERION FOR DESIRABLE AIR IS 100 ppb OF SO_2 FOR A DAILY AVERAGE AS COMPARED TO THE U.S. STANDARD OF 140 ppb FOR A 24-HOUR RUNNING AVERAGE. THE EVIDENCE OF THE LONG RANGE TRANSPORT OF SO_2 IS CLEARLY INDICATED BY THE MEASUREMENTS AT RURAL STATIONS. INVERHURON ON THE SHORE OF LAKE HURON RARELY RECORDS HOURLY LEVELS ABOVE 20 ppb BUT ON THE 20th RECORDED A 24-HOUR AVERAGE OF 40 ppb. THE RURAL SIMCOE STATION LOCATED NORTH OF LAKE ERIE RECORDED A 24-HOUR AVERAGE OF 70 ppb. THERE ARE NO SIGNIFICANT LOCAL SOURCES OF SULPHUR DIOXIDE IN THE SOUTHWEST DIRECTION, THAT IS THE DIRECTION UPWIND OF THESE STATIONS ON FEBRUARY 20th, AS INDICATED BY THE BACK - TRAJECTORIES FOR THAT DAY FOR THOSE LOCATIONS (FIGURE 6). BACK TRAJECTORIES WHICH ARE THE ESTIMATED LOCATIONS OF PARCELS OF AIR IN 6 HOUR STEPS UP TO 1 A.M. LOCAL TIME IN THE MORNING OF THE 19th, 20th, 21st ARE SHOWN FOR OTHER LOCATIONS IN FIGURES 7, 8 and 9. THESE TRAJECTORIES CLEARLY SHOW THE AIR PARCELS ORIGINATING IN THE NEIGHBORING STATES.

TOTAL SUSPENDED PARTICULATE MATTER (TSP) WHICH ARE MONITORED EVERY SIXTH DAY, WERE MONITORED ON FEB. 20th. THE LEVELS OF TSP AND THE SULPHATE COMPONENT WERE VERY MUCH ABOVE NORMAL FOR BOTH

RURAL AND URBAN STATIONS ACROSS THE AREA. (TABLES 2A and 2B.) FOR A DAILY MEASUREMENT OF TSP, ONTARIO'S CRITERION FOR DESIRABLE AIR IS 120 ug./m^3. THIS WAS EXCEEDED AT SEVERAL LOCATIONS. THE CONSISTENT HIGH SULPHATE COMPONENT WHICH IS INDICATIVE OF LONG RANGE TRANSPORT AVERAGED ABOUT 30% OF THE TSP MEASURED AT ONTARIO LOCATIONS. REDUCED VISIBILITIES HAVE BEEN RELATED TO HIGH SULPHATE CONCENTRATIONS.[1,2] THE U.S. - E.P.A REPORT, "VISIBILITY IN THE NORTHEAST"[2] CONCLUDED "THAT THE MAIN CONTRIBUTOR TO HAZE IN THE NORTHEAST IS SULPHATE, WHICH TYPICALLY ACCOUNTS FOR APPROXIMATELY 50% OF THE TOTAL EXT INCTION." VISIBILITIES AT ONTARIO AIRPORTS WERE ABOUT 15 MI. ON THE AFTERNOON OF THE 19th WHILE ON THE AFTERNOON OF THE 20th, THE REPORTED VISIBILITIES WERE 6 MI. AND LESS. TABLE 3 SHOWS THE VISIBILITIES AT SOME LOCATIONS IN PENNSYLVANIA AND NEW YORK.

ONTARIO'S AIR POLLUTION CONTROL LEGISLATION[3] INCLUDES A REGULATORY SYSTEM THAT ALLOWS THE GOVERNMENT CONTROL AGENCY TO ORDER OWNERS OF SIGNIFICANT EMITTERS OF SULPHUR DIOXIDE AND/OR PARTICULATE MATTER TO CURTAIL THEIR EMISSIONS DURING HIGH POLLUTION POTENTIAL CONDITIONS. ALERTS ARE ISSUED ON THE BASIS OF WEATHER FORECASTS AND ONTARIO's AIR POLLUTION INDEX (API) WHICH IS A FUNCTION OF THE 24-HOUR RUNNING AVERAGES OF SULPHUR DIOXIDE AND SUSPENDED PARTICULATE MATTER MEASURED IN TERMS OF THE COEFFICIENT OF HAZE. AN API OF LESS THAN 32 IS CONSIDERED ACCEPTABLE. AT THESE LEVELS CONCENTRATIONS OF SO_2 AND TSP SHOULD HAVE LITTLE OR NO EFFECT ON HUMAN HEALTH. AT THE ADVISORY LEVEL OF 32, WITH METEOROLOGICAL CONDITIONS FORECAST TO REMAIN ADVERSE FOR SIX HOURS, SIGNIFICANT SOURCES OF POLLUTION IN THE COMMUNITY IN WHICH A HIGH API OCCURS ARE REQUESTED TO CURTAIL

OPERATIONS. THE SYSTEM IS DESIGNED WITH THE OBJECTIVE OF PREVENTING THE API FROM REACHING A LEVEL OF 57 IN ANY ONTARIO COMMUNITY. AT THIS LEVEL, RESEARCH BY DR. P.J. LAWTHER[4] INDICATED THAT HIS PATIENTS WITH CHRONIC RESPIRATORY DISEASE WERE NOTED TO EXPERIENCE AN ACCENTUATION OF SYMPTOMS. EVIDENCE OF THE RELATIONSHIP OF THE API AND HEALTH WERE REPORTED BY LEVY ET AL[5] WHO RELATED THE API WITH INCREASING HOSPITAL ADMISSIONS FOR ACUTE EXACERBATIONS AMONG ADULTS WITH CHRONIC RESPIRATORY ILLNESS AND CHILDREN WITH ACCUTE RESPIRATORY DISEASE.

DURING THE INCIDENT OF FEBRUARY 19 - 21, THE API EXCEEDED 32 IN THREE ONTARIO CITIES WHERE SIGNIFICANT SOURCES WERE REQUESTED TO CURTAIL EMISSIONS. SARNIA IN THE SOUTHWEST, FIRST TO EXCEED 32 AT 10:00 A.M. OF THE 20th, REACHED A MAXIMUM AT 43 AT 3:00 P.M. OF THAT DAY. HAMILTON AND TORONTO API EXCEEDED 32 AT 4:00 A.M. AND 6:00 A.M. OF THE 21st REACHING MAXIMUM LEVELS OF 34 AND 33 RESPECTIVELY. THE INCIDENT IS OF INTEREST IN THAT ALTHOUGH A SIGNIFICANT CONTRIBUTION TO POLLUTANT LEVELS, ESTIMATED AT APPROXIMATELY 50%, ORIGINATED IN UNITED STATES, CANADIAN SOURCES HAD TO BEAR THE COST OF CURTAILING EMISSIONS TO PREVENT ADDITIONAL AIR QUALITY DETERIORATION AND POSSIBLE HEALTH EFFECTS.

WHILE WE HAVE DESCRIBED IN DETAIL ONE POLLUTION INCIDENT OF THE LONG RANGE TRANSPORT OF POLLUTANTS, THIS IS NOT AN ISOLATED CASE. SULPHUR DIOXIDE WAS SHOWN TO HAVE BEEN TRANSPORTED INTO SOURTHERN ONTARIO ON JANUARY 24, 1977. A RURAL STATION NORTH OF LAKE ERIE RECORDED 24-AVERAGE CONCENTRATION ABOVE ONTARIO'S CRITERION.[6] THERE ARE IN THE SCIENTIFIC LITERATURE MANY DOCUMENTED ACCOUNTS TO THE TRANSPORT OF POLLUTANTS SUCH AS SULPHATES, NITRATES AND OZONE.[7,8,9,10,11]

THE STUDIES FOR THE NORTHEASTERN UNITED STATES AND ONTARIO OFTEN SHOW THEIR OCCURRENCE TO BE DIRECTLY RELATED WITH THE BACK-OF-THE-HIGH SOUTHWESTERLY CIRCULATION OF STABLE AIR.

FOR THE RECEPTOR AREAS OF NEW YORK, PENNSYLVANIA AND ONTARIO THIS AIR FREQUENTLY FIRST PASSES THROUGH THE INDUSTRIALIZED OHIO VALLEY THAT HAS MANY OF THE LARGE COAL-FIRED POWER PLANTS REQUESTING A RELAXATION OF STANDARDS. FIFTEEN MAJOR INCIDENTS OF HIGH SULPHATES SUCH AS THAT WHICH HAS BEEN DESCRIBED BY DR. LYONS FOR THE PERIOD AUGUST 16 to 28, 1976, OCCURRED DURING THE PERIOD OF 1976 - 1980.

I WOULD NOW LIKE TO TOUCH ON THE TRANSPORT OF OZONE, INTO THE NEW YORK - PENNSYLVANIA - ONTARIO AREA, BECAUSE OZONE IS BELIEVED TO BE A PROMOTER OF SO_2 OXIDATION TO SULFATE AND RESULTANT HAZE FORMATION.

DURING THE SUMMER ONTARIO OBSERVES THAT AIR MASSES FROM THE SOUTH CONTAINS OZONE AS WELL AS SULPHATES. OZONE LEVELS IN BOTH RURAL AND URBAN AREAS OFTEN EXCEED 80 ppb, the ONTARIO CRITERION FOR DESIRABLE AIR AS WELL AS THE U.S. - E.P.A. STANDARD OF 120 ppb. FIGURE 10 SHOWS THE LOCATION OF ONTARIO's OZONE MONITORING STATIONS. AS CAN BE SEEN FROM TABLE 4. THE HOURLY AVERAGE OZONE LEVELS HAVE EXCEEDED 200 ppb, THE FIRST ALERT LEVEL IN THE BAY AREA OF CALIFORNIA. THE NUMBER OF EPISODE DAYS THAT OZONE EXCEEDED ONTARIO'S CRITERION ATLEAST ONE OF THE MONITORING STATIONS IN OPERATION SINCE 1978 RANGE FROM 43 IN 1978 TO 14 IN 1979 AND 1980. FROM MAY 15 to SEPTEMBER 15 WHEN ELEVATED LEVELS OF OZONE MAY BE EXPECTED IN ONTARIO, THE CRITERION WAS

EXCEEDED ON 110 DAYS OR ALMOST 20% OF THE TOTAL NUMBER OF DAYS DURING THE 5 YEAR PERIOD OF 1976 TO 1980.

BACK - TRAJECTORIES OF AIR PARCELS SHOW THAT ON A CONSISTANT BASIS AIR ARRIVING IN SOUTHERN ONTARIO WITH A HIGH SULPHATE AND/OR OZONE CONTENT AND POOR VISIBILITY ORIGINATES SOUTH OF THE GREAT LAKES.[8] THE RESULTS ARE SIMILAR TO THAT REPORTED FOR NEW YORK STATE[9] THAT INDICATED COMPARATIVELY CLEAN AIR TO BE ASSOCIATED WITH A NORTHERLY CIRCULATION AND CONTAMINATED AIR WITH POOR VISIBILITIES WITH CIRCULATIONS FROM THE SOUTHWEST. IN THE SUMMER, IT IS A COMBINATION OF SULPHATES AND OZONE THAT ARRIVES WITH A SOUTHERLY CIRCULATION AND REDUCES VISIBILITY. IN THE WINTER, SULPHUR DIOXIDE AND PARTICULATE MATTER WITH A HIGH COMPONENT OF SULPHATES HAVE BEEN NOTED TO BE ASSOCIATED WITH THIS AIR MASS ORIGINATING SOUTH OF US.

ANOTHER IMPACT OF TRANSPORTED POLLUTANTS OTHER THAN A REDUCTION IN VISIBILITY OCCURS AS A RESULT OF THEIR DEPOSITION FROM THE ATMOSPHERE. HERE AGAIN BACK TRAJECTORY ANALYSES WERE USED TO DETERMINE THE SOURCE AREA OF SUCH IMPACT. DATA FROM PRECIPITATION COLLECTORS OPERATED IN THE MUSKOKA - HALIBURTON AREA OF SOUTH - CENTRAL ONTARIO FOR ALMOST A 3 YEAR PERIOD, COMBINED WITH BACK - TRAJECTORY ANALYSES, SHOWED THAT ABOUT 75% OF THE PRECIPITATION EVENTS AND MOREOVER APPROXIMATELY 80% OF THE WET ACID DEPOSITION AT THE SITE WERE ASSOCIATED WITH AIR MASSES ARRIVING FROM THE SOUTH AND SOUTHWEST. COMPARATIVELY A SMALL PERCENTAGE OF THE LOADINGS CAME FROM THE NORTH AND NORTHWEST WHERE SUDBURY SMELTERS ARE LOCATED.

I MENTION THIS STUDY AS ANOTHER PIECE OF EVIDENCE WHICH WE USED IN CONSIDERING THE CONTROL OF ONTARIO SOURCES.

MORE GENERALLY, ALL THE BACK - TRAJECTORY STUDIES I HAVE DISCUSSED LIKE THOSE OF DR. PARRY SAMSON, ILLUSTRATE CLEARLY THE SIGNIFICANT TRANSPORT OF POLLUTANTS INTO NEW YORK, PENNSYLVANIA AND ONTARIO. WE FEEL THAT IT IS TIME EPA TAKES A POSITIVE ROLE IN CONTROLLING THESE TRANSBOUNDARY POLLUTION PROBLEMS.

FIG. 1 MONDAY, FEBRUARY 19, 1979

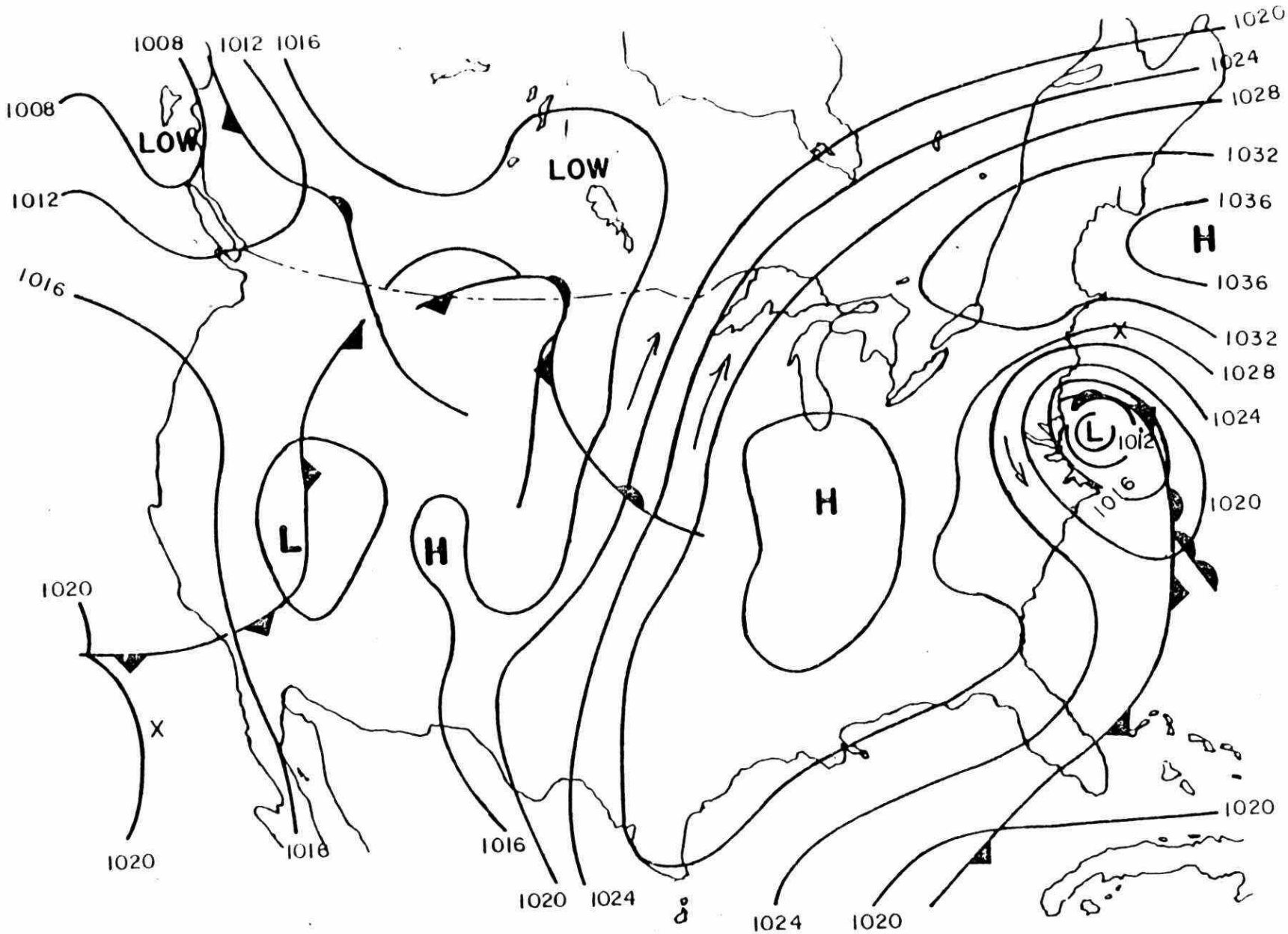


FIG. 2 TUESDAY, FEBRUARY 20, 1979

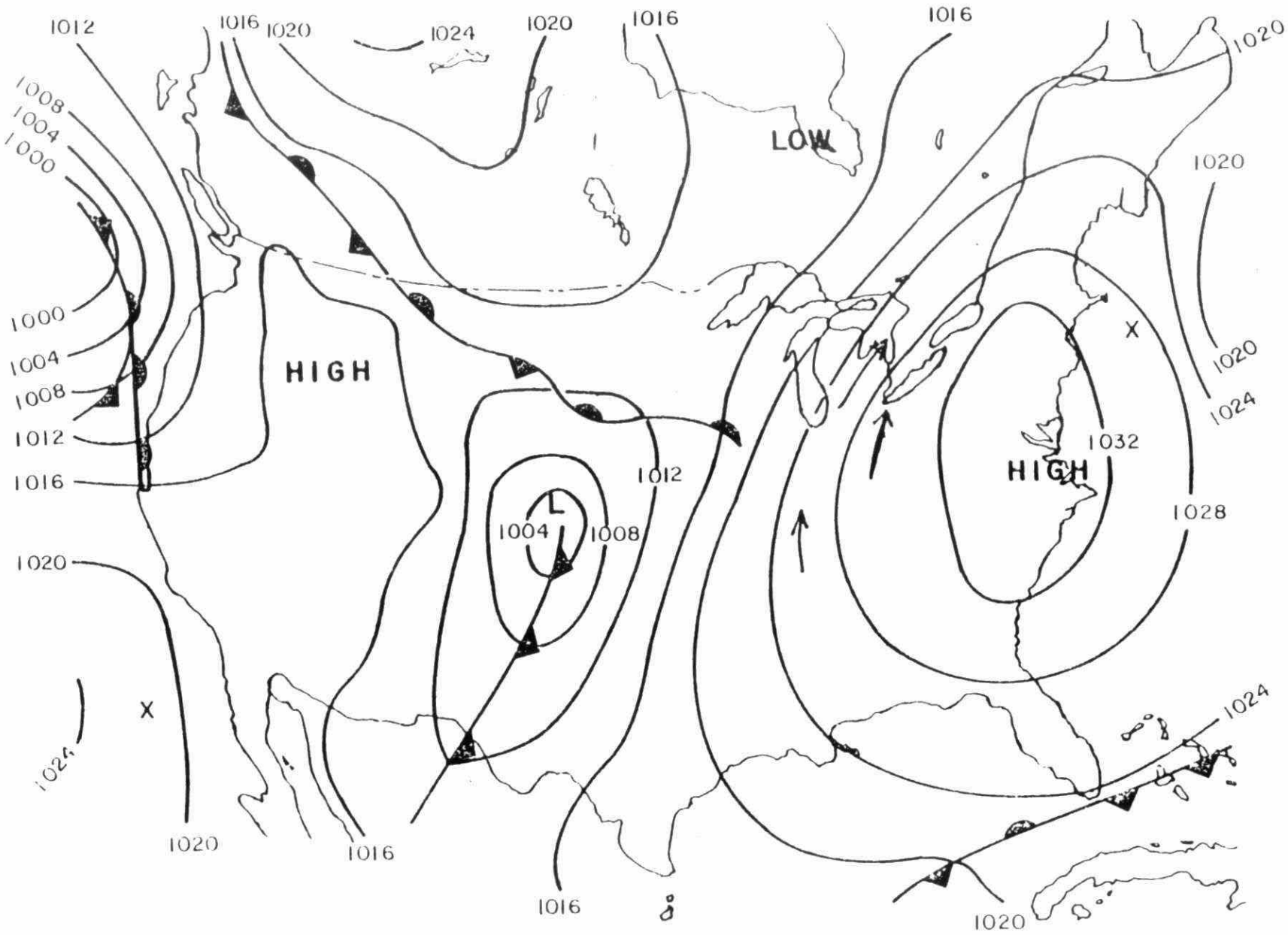


FIG. 3 WEDNESDAY, FEBRUARY 21, 1979

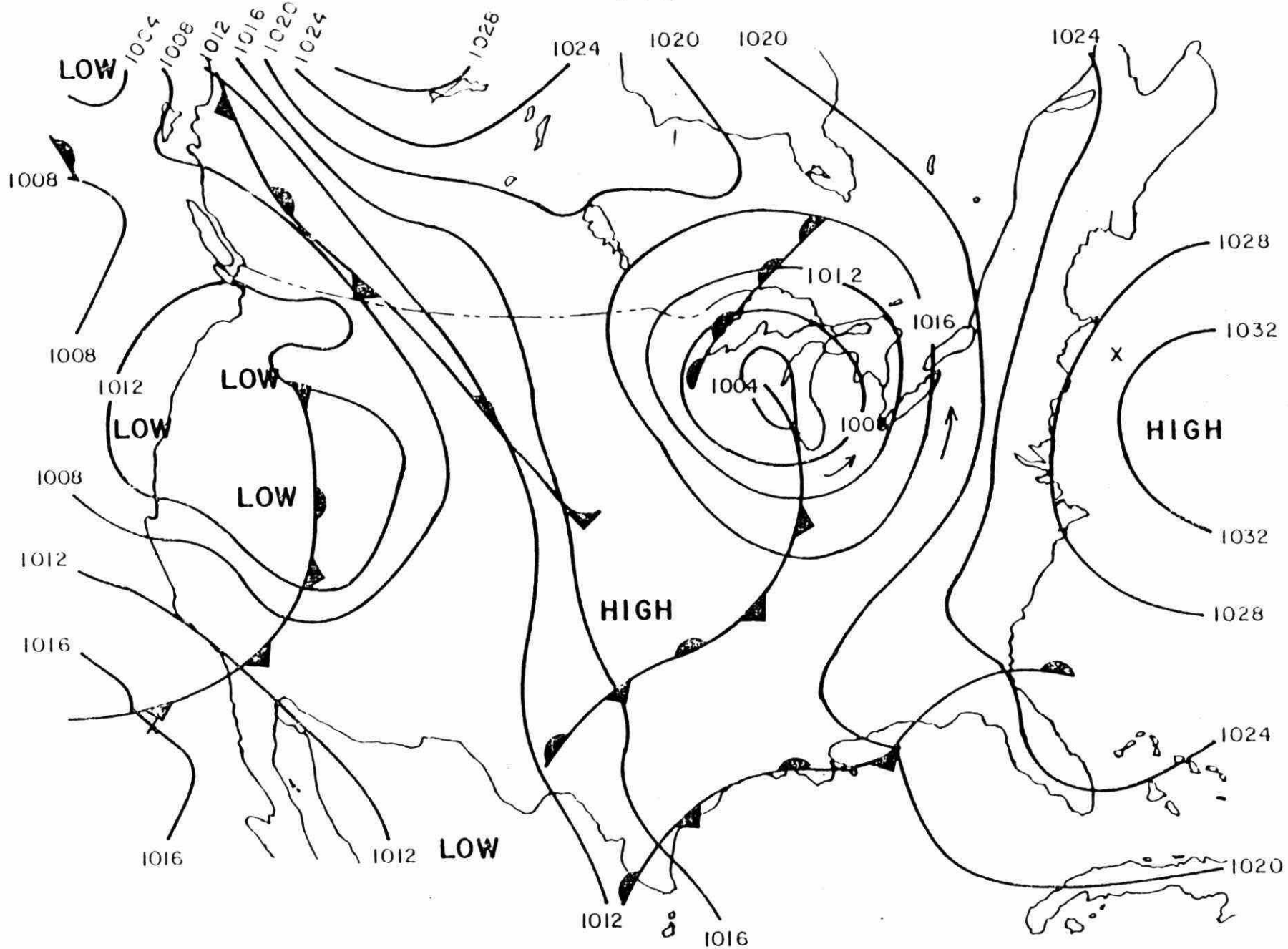
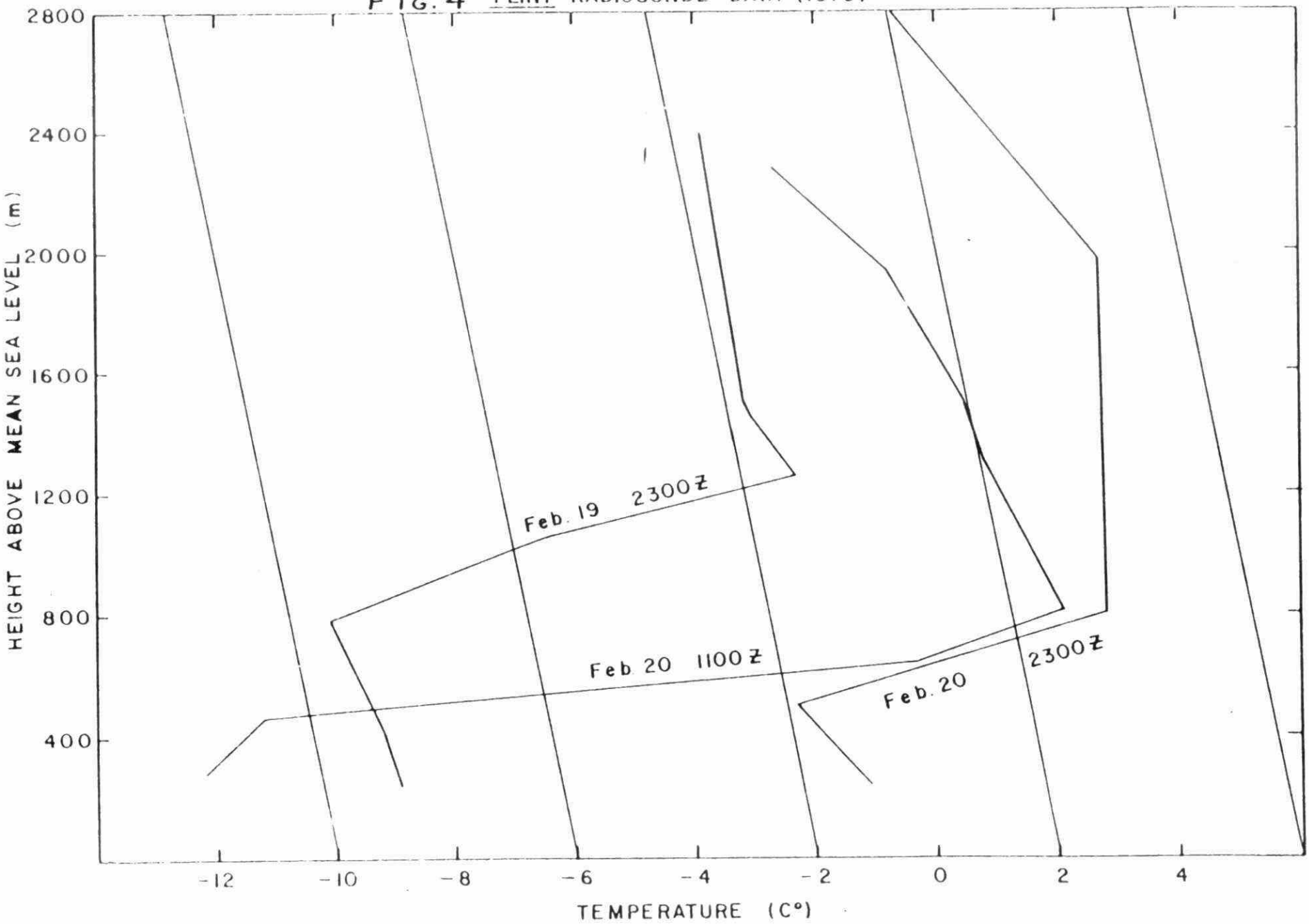


FIG. 4 FLINT RADIOSONDE DATA (1979)



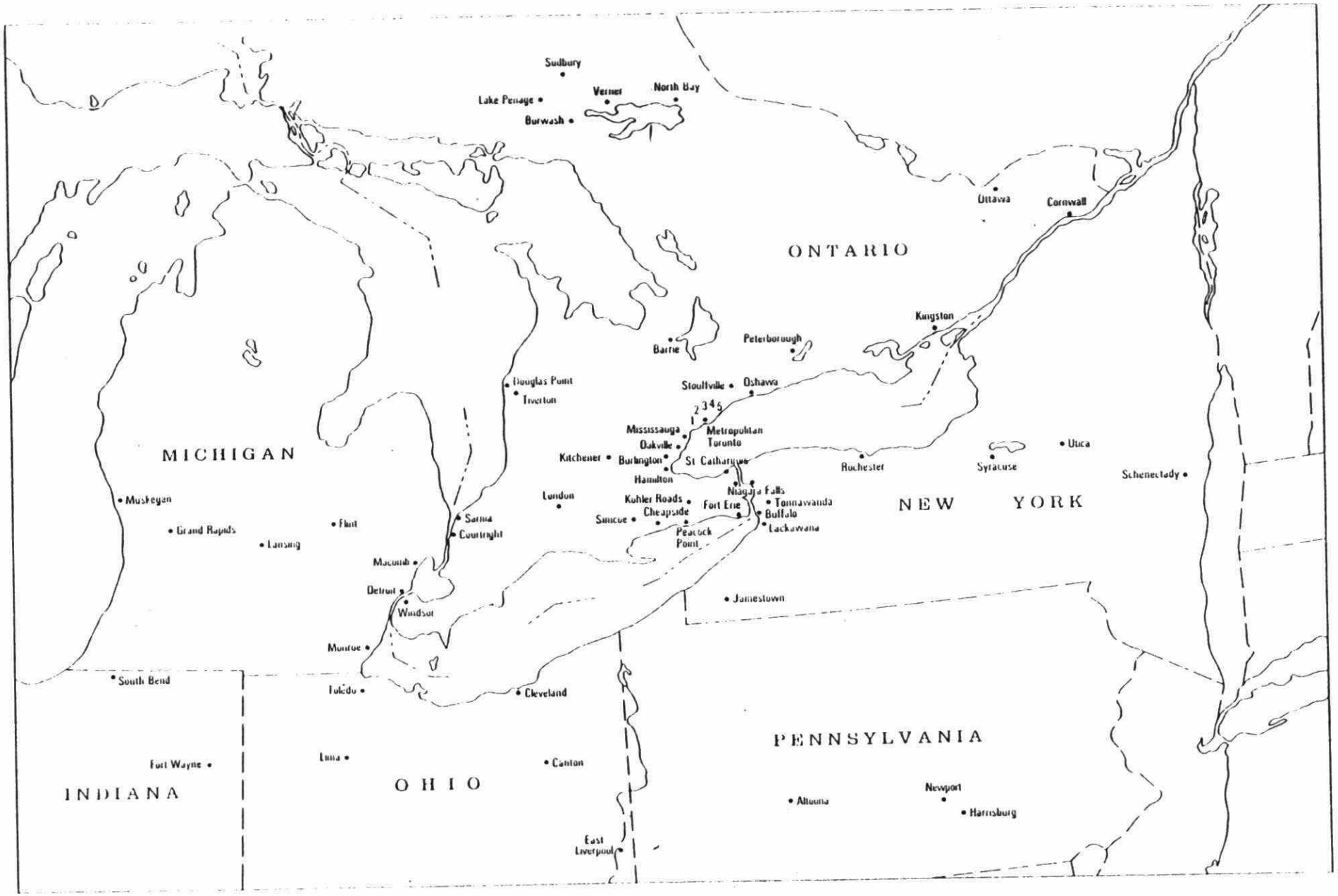


FIG. 5. Map Showing Locations of Monitoring Stations.

TWENTY-FOUR HOUR AVERAGE

SULPHUR DIOXIDE CONCENTRATIONS (ppb) 1979

Location		19 Feb	20 Feb	21 Feb
Windsor		60	80	40
Sarnia		60	130	40
Courtright		30	70	40
London		20	50	30
Douglas Point		11	53	33
Inverhuron (Tiverton)		10	40	20
Peacock Point		22	59	31
Simcoe		-	70	50
Kohler Road		24	61	49
Cheapside		0	60	40
Kitchener		10	40	30
Niagara Falls		20	50	40
St. Catharines		20	50	30
Ft. Erie		10	70	40
Hamilton		20	50	50
Metro Toronto	(1)	30	80	40
	(2)	45	106	28
	(3)	40	110	30
	(4)	20	60	30
	(5)	20	50	30
Burlington		30	40	50
Oakville		10	60	40
Oshawa		30	100	50
Mississauga		30	50	20
Barrie		20	50	50
Stouffville		0	40	30
Ottawa		20	70	50
Cornwall		50	60	70
Kingston		11	44	23
Peterborough		10	50	30
North Bay		10	40	40
Verner		10	40	40
Sudbury		20	40	30
Lake Penage		0	20	20
Burwash		0	30	40

TWENTY-FOUR HOUR AVERAGE

SULPHUR DIOXIDE CONCENTRATIONS (ppb) 1979 (cont'd)

Location	19 Feb	20 Feb	21 Feb
Jamestown, NY	14	49	37
Buffalo, NY (1)	49	102	41
(2)	28	75	44
Lackawanna, NY	40	82	41
Tonawanda, NY	33	107	51
Niagara Falls, NY	42	73	45
Rochester, NY	47	64	-
Utica, NY	21	43	33
Syracuse, NY (1)	26	49	34
(2)	19	42	29
Schenectady, NY	30	44	52
Altoona, Penn	45	73	
Newport, Penn	15	34	
Harrisburg, Penn	34	72	
Bay County, Michigan	20	50	20
Flint, Michigan 30	50	20	
Lansing, Michigan	40	60	30
Grand Rapids, Michigan	40	60	20
Macomb County, Michigan	30	70	20
Monroe, Michigan	40	70	30
Muskegon, Michigan	30	70	40
Detroit, Michigan	20-40	50-100	10-30
Milan, Michigan	20	50	20

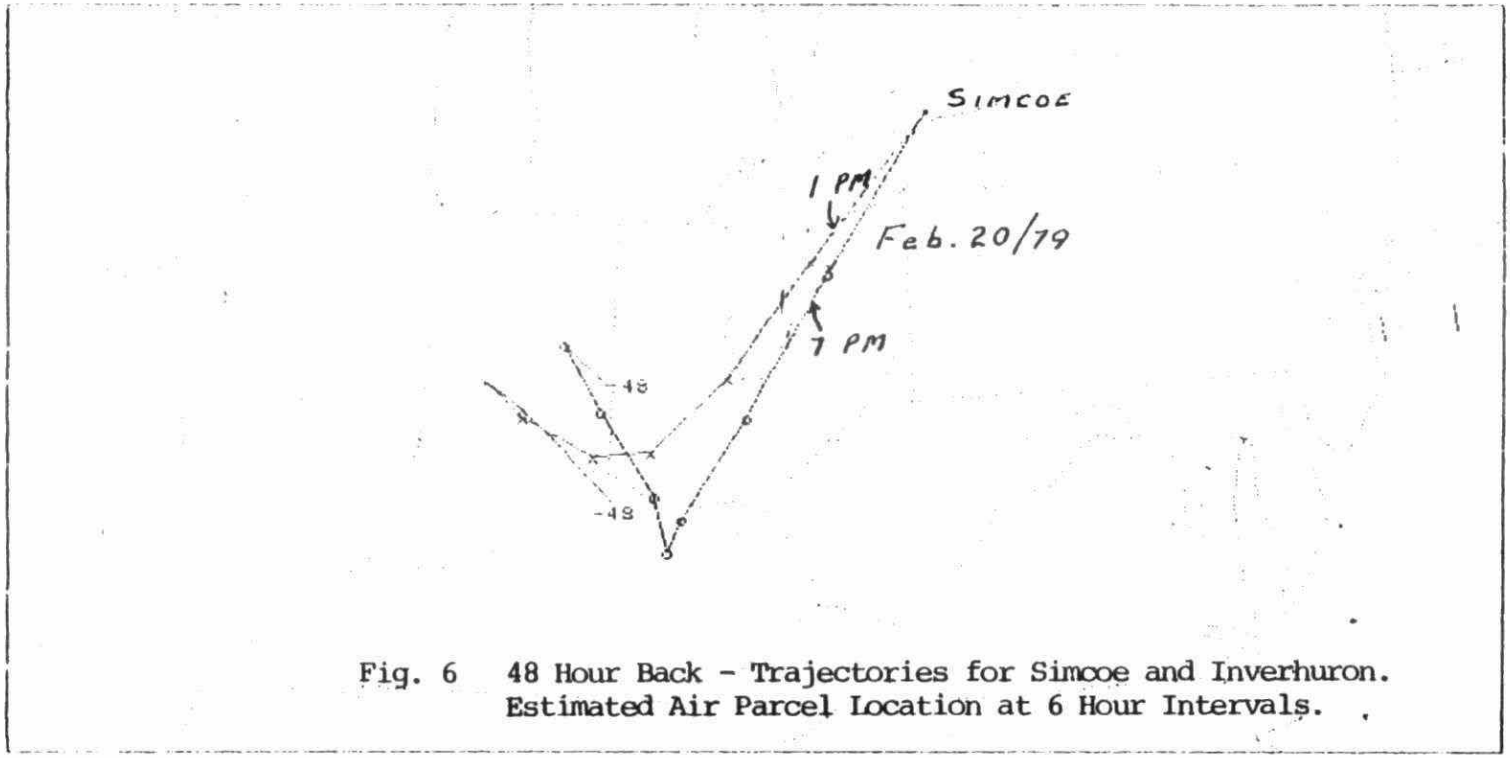
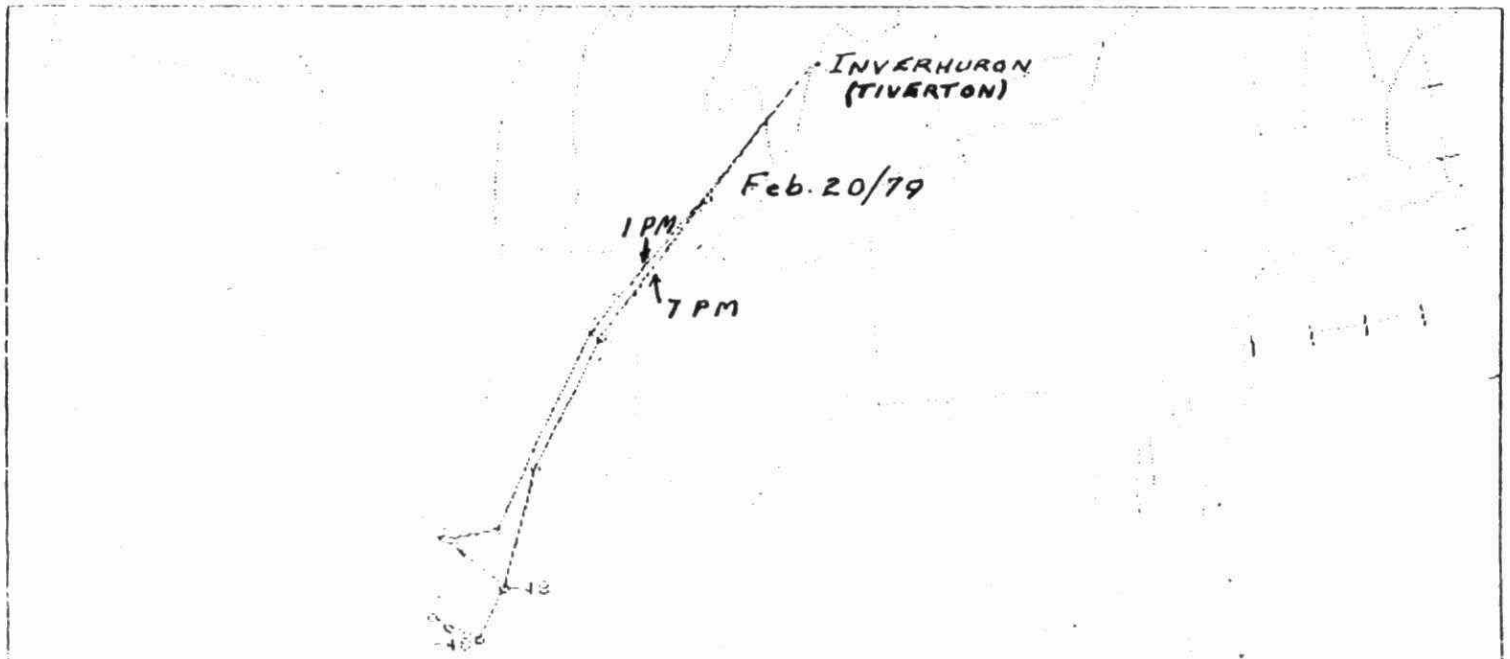
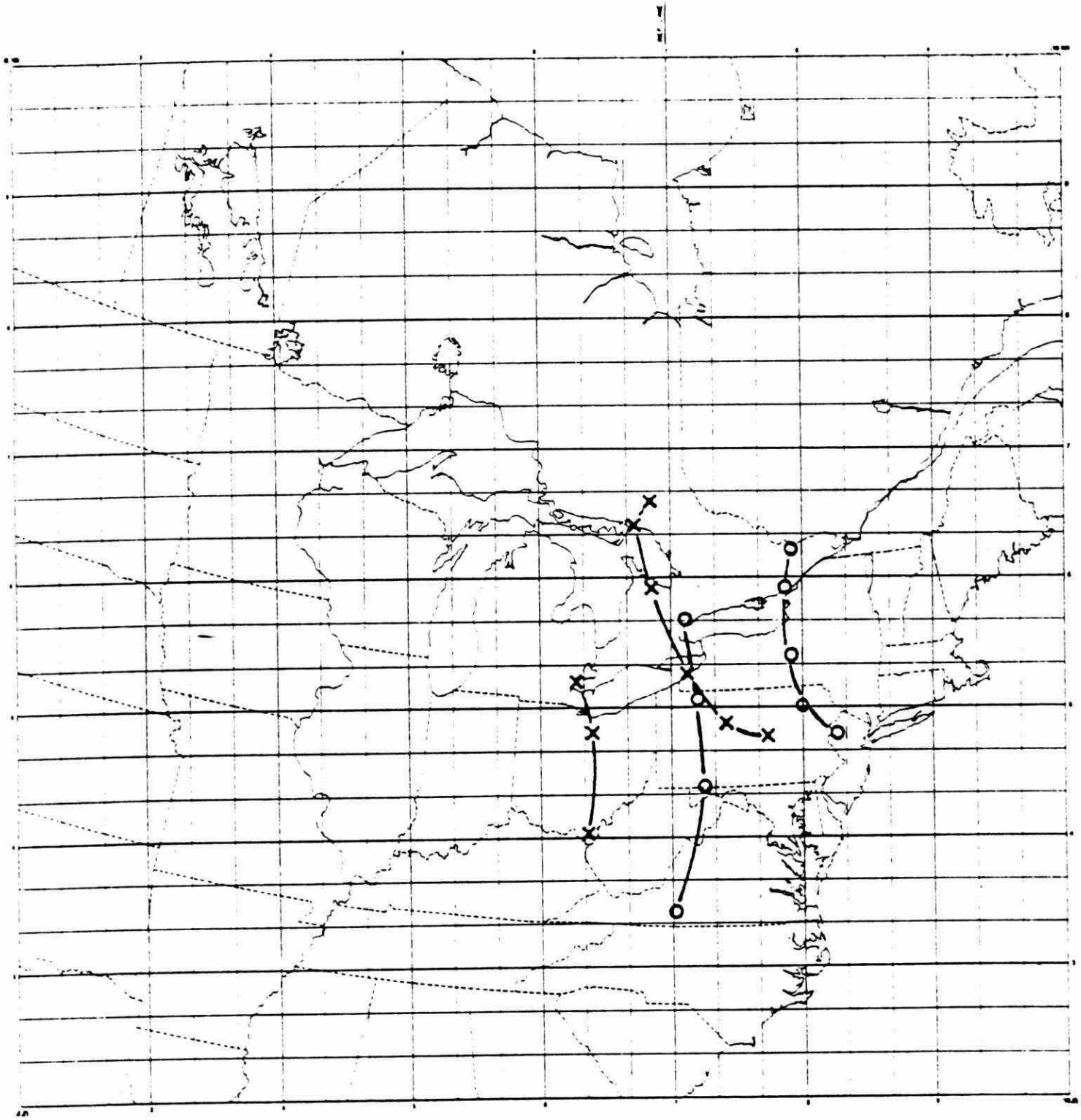


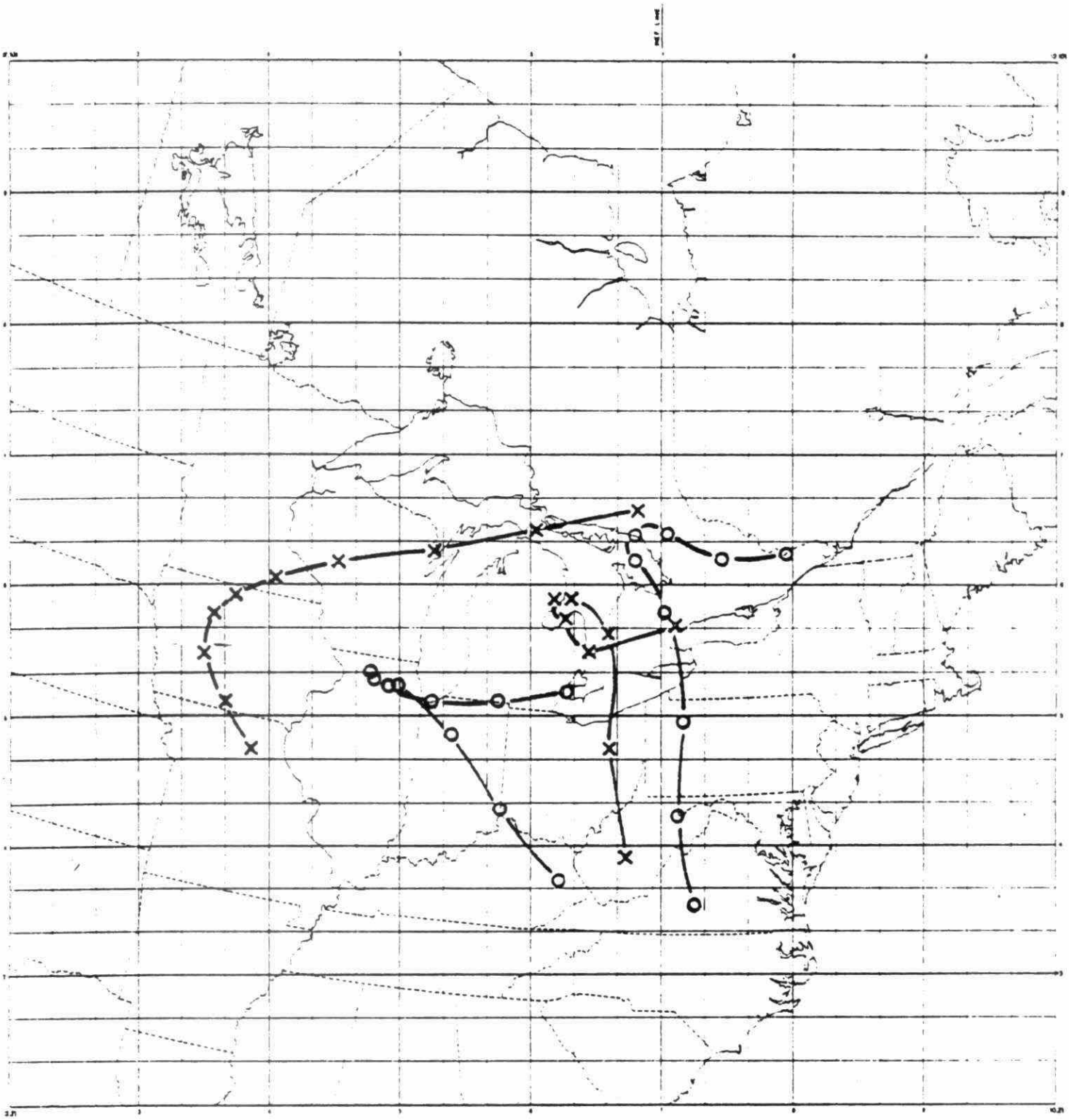
Fig. 6 48 Hour Back - Trajectories for Simcoe and Inverhuron. Estimated Air Parcel Location at 6 Hour Intervals.





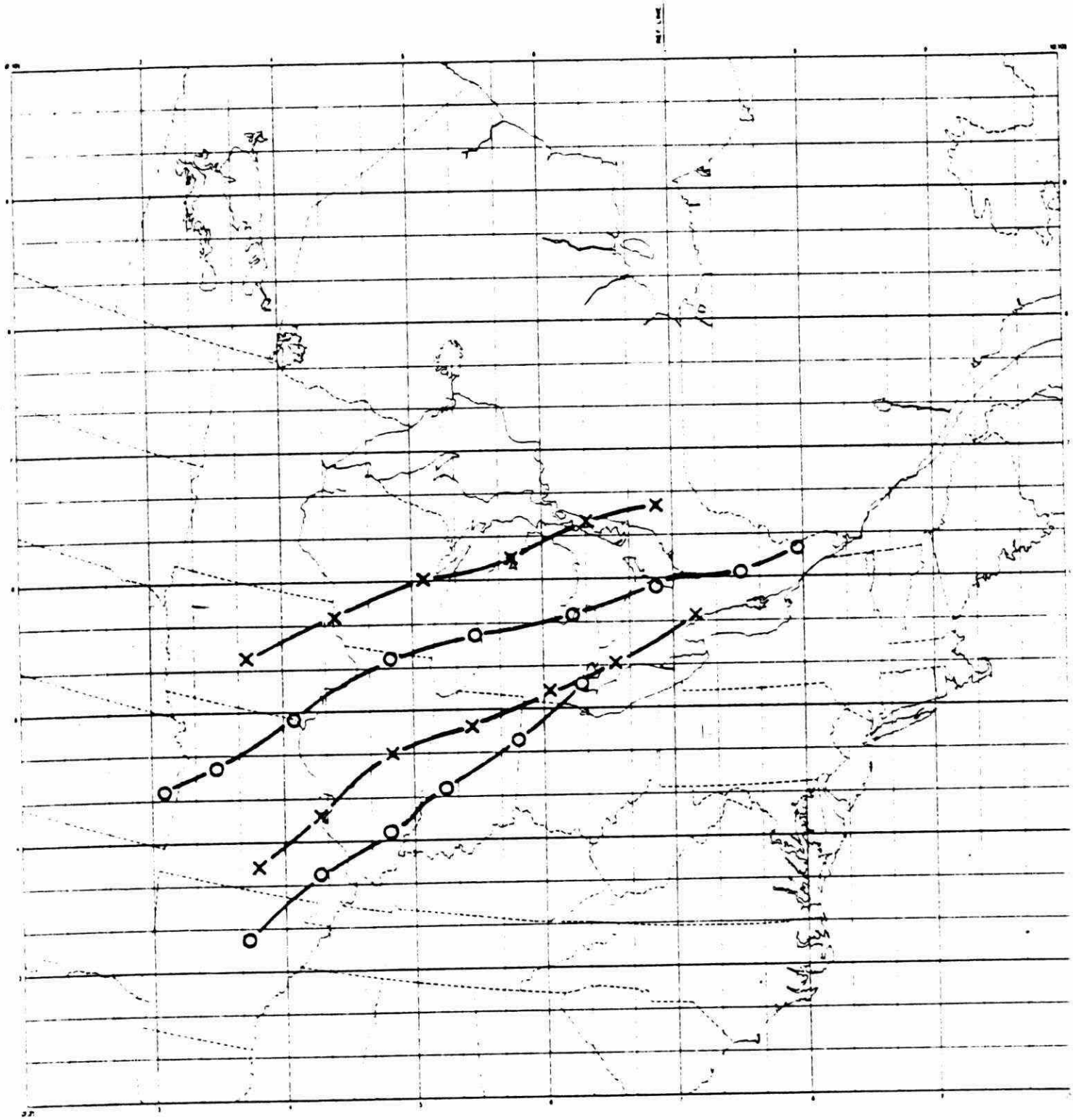
Back-trajectories showing Estimated Air Parcel locations at 6 hour intervals Terminating at 0100 EST Feb. 19/79

FIG. 7



Back-trajectories showing Estimated Air Parcel locations at 6 hour intervals Terminating at 0100 EST Feb. 20/73

FIG. 8



Back-trajectories showing Estimated Air Parcel locations at 6 hour intervals Terminating at 0100 EST Feb. 21/79

FIG. 9

Table
2(a)

Concentrations of Total Suspended Particulate Matter,
Sulphate, and Nitrate (ug/m^3)
20 February 1979

Location		TSP	Sulphate	Nitrate
Windsor, Ont		141	34.5	10.9
Courtright, Ont.		132	41.0	4.6
Sarnia, Ont.		181	49.2	20.9
London, Ont.		92	30.7	4.2
St. Catharines, Ont.		83	28.5	4.5
Hamilton Ont.		117	34.5	4.3
Metro Toronto, Ont.	(1)	116	33.8	7.0
	(2)	144	28.3	13.3
	(3)	77	25.5	5.9
	(4)	134	34.0	10.7
Oakville, Ont.		113	35.0	4.2
Pickering, Ont.		147	35.3	8.2
Oshawa, Ont.		45	7.1	1.7
Mississauga, Ont.		95	23.3	6.3
Ottawa, Ont.		68	23.9	2.6
Belleville, Ont.		90	30.5	1.9
Brockville, Ont.		50	19.1	0.8
Cornwall, Ont.		93	25.6	5.7
Peterborough, Ont.		75	26.3	2.2
North Bay, Ont.		70	27.2	1.5
Sudbury, Ont.		56	24.7	2.9
Altoona, PA		96	36.8	-
Rochester, PA		201	31.8	-
Beaver Falls, PA		212	35.9	-
Monessen, PA		229	45.7	-
Donora, PA		285	51.2	-
Sharon, PA		201	32.8	-
Washington, PA		170	27.6	-
Erie, PA		63	18.3	-
Farrell, PA		91	19.9	-
Harrisburg, PA		116	29.0	-

CONCENTRATIONS OF TOTAL SUSPENDED PARTICULATE MATTER, SULPHATE AND NITRATE (ug/m3)

20 FEBRUARY 1979

Location		TSP	Sulphate	Nitrate
Buffalo, NY	(1)	180	37.8	8.5
	(2)	85	21.0	2.5
Niagara Falls, NY		30	5.7	2.1
Jamestown, NY		57	19.6	0.6
Poughkeepsie, NY		91	19.6	5.8
Rochester, NY	(1)	75	20.1	2.8
	(2)	95	19.2	3.3
	(3)	79	19.4	3.1
	(4)	80	19.5	3.1
Utica, NY		69	17.9	3.7
Syracuse, NY		145	17.7	6.1
Troy, NY		52	17.8	1.0
Hamstead, Long Island, NY		101	18.5	8.6
Campbell, Ohio		182	47.9	15.5
Youngstown, Ohio		112-223	46.0	9.7
Canton, Ohio		74-184	22-42.4	10-17
Toledo, Ohio		88-130	28.9	8.4
Defiance, Ohio		52-67	18.2	18.9
Detroit, Michigan		106-288	-	-
Lansing, Michigan		69-91	-	-
Muskegon, Michigan		53-69	-	-
Grand Rapids, Michigan		96	-	-

TABLE 3

VISIBILITY IN MILES IN THE AFTERNOON OF FEB. 19 AND FEB. 20/79

LOCATION	FEB. 19	FEB. 20
PITTSBURGH, PA.	10	5
BRADFORD	25	10
PHILLIPSBURGH	27	4
ALTOONA	7	5
BUFFALO, NY	12	7
ROCHESTER	10	7
BINGHAMPTON	25	7

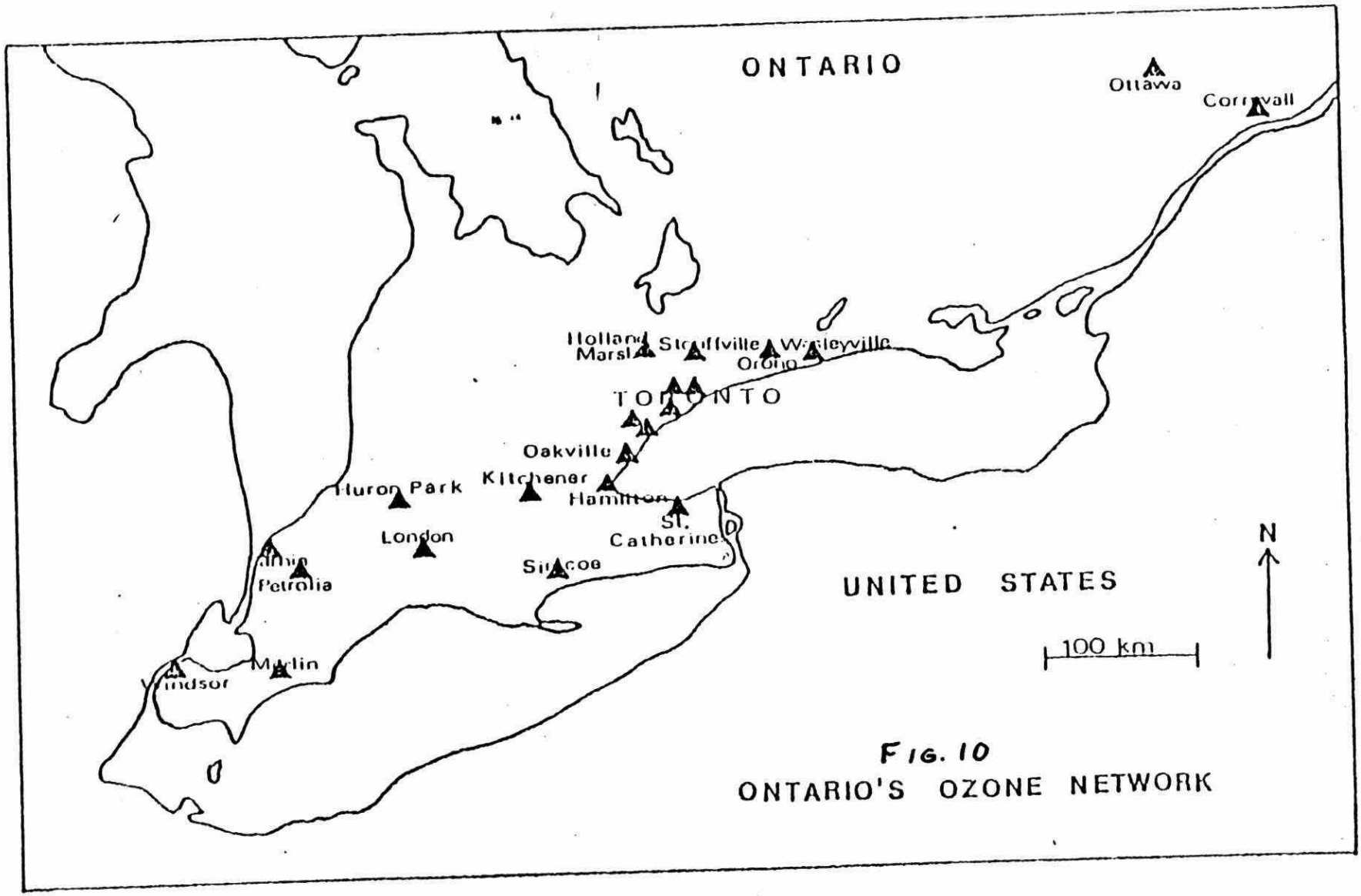


FIG. 10
ONTARIO'S OZONE NETWORK

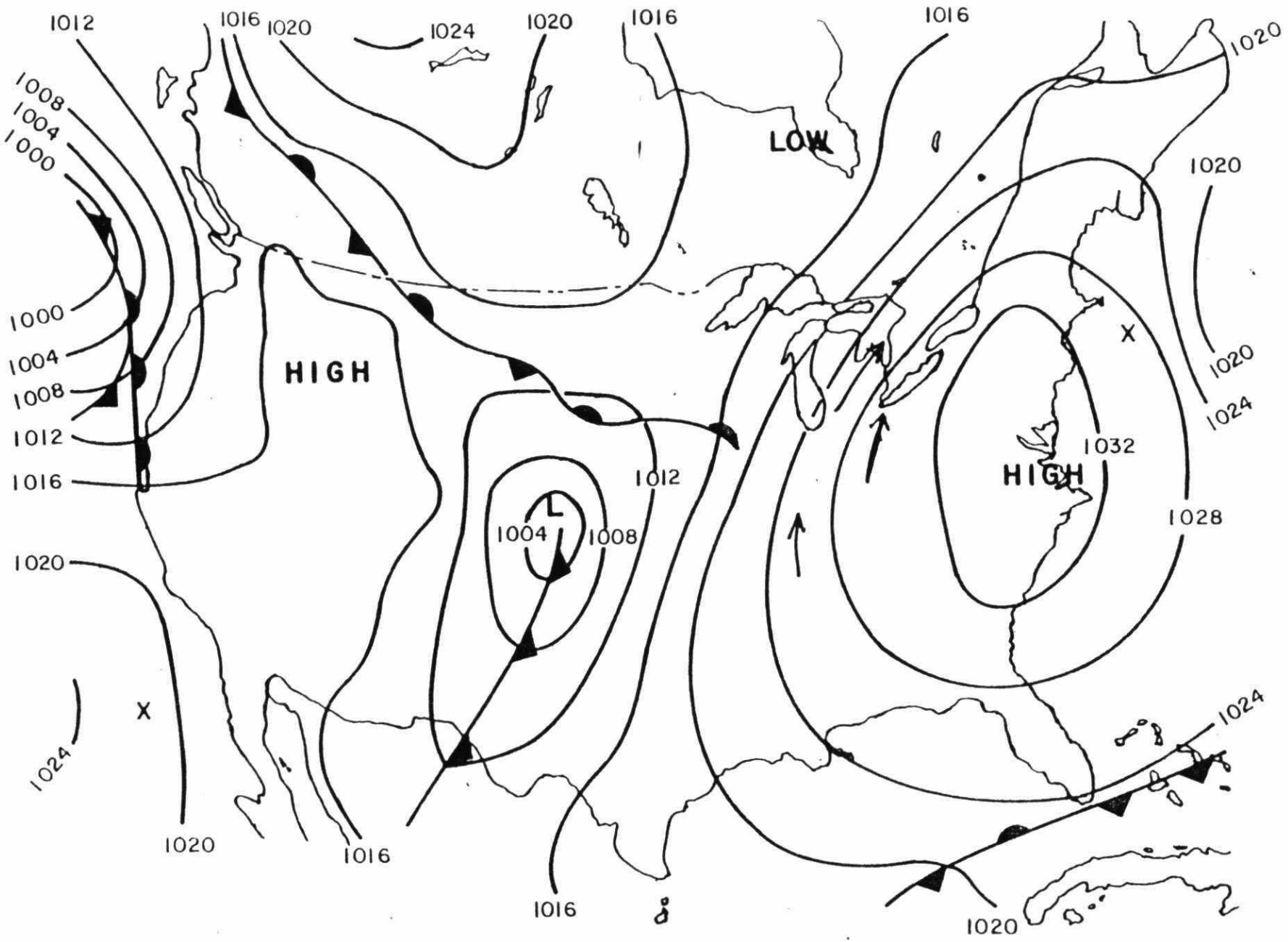
TABLE 4

MAXIMUM ONE HOUR OZONE CONCENTRATIONS (PPB)

	1976	1977	1978	1979	1980
HURON PARK	—*	137	134	123	120
WINDSOR	173	144	211	120	131
MERLIN	—	167	137	158	137
SARNIA	137	168	144	159	155
PETROLIA	—	146	148	148	125
LONDON	112	120	111	101	111
SIMCOE	139	133	171	148	99
KITCHENER	117	111	137	115	98
ST. CATHARINES	131	127	148	124	138
HAMILTON	128	93	119	112	107
TORONTO 1	138	110	135	155	121
TORONTO 2	—	—	102	106	77
SCARBOROUGH	142	107	128	165	108
NORTH YORK	139	—	140	99	125
ETOBICOKE 1	124	126	135	92	129
ETOBICOKE 2	106	111	116	126	107
MISSISSAUGA	—	—	129	134	120
OAKVILLE	124	122	142	129	109
HOLLAND MARSH	218	129	124	-	-
STOUFFVILLE	163	152	142	172	137
OTTAWA	96	91	133	96	83
CORNWALL	119	89	116	114	100
WESLEYVILLE	178	—	171	-	-
ORONO	162	176	181	149	-
ONTARIO	218	176	211	172	155

* - no data available.

FIG. 2 TUESDAY, FEBRUARY 20, 1979



THE USE OF LAKE STUDIES IN MEASURING ATMOSPHERIC POLLUTION

T. BRYDGES

GOOD EVENING, MY NAME IS TOM BRYDGES. I AM THE SUPERVISOR OF THE LIMNOLOGY SECTION OF THE ONTARIO MINISTRY OF THE ENVIRONMENT, WATER RESOURCES BRANCH.

THE LIMNOLOGY SECTION IS A GROUP OF ABOUT 35 SCIENTISTS AND TECHNICIANS CONDUCTING A NUMBER OF LAKE STUDIES INCLUDING SOME RELATED TO THE SUBJECT OF THESE HEARINGS - THE INFLUENCE OF SULPHUR DIOXIDE ON THE ENVIRONMENT.

MY BRIEF COMMENTS WILL GIVE YOU SOME UNDERSTANDING OF HOW OUR LAKE STUDIES GIVE DIRECT INFORMATION ABOUT THE DEGREE OF ATMOSPHERIC POLLUTION AND HOW THE SURFACE WATER QUALITY REACTS TO THAT POLLUTION.

ONTARIO OPERATES A NETWORK OF AIR QUALITY MONITORING STATIONS THAT MEASURE SULPHUR DIOXIDE IN THE AMBIENT AIR AS WELL AS THE WET DEPOSITION OF A VARIETY OF COMPOUNDS.

BULK COLLECTORS ARE OPEN AT ALL TIMES AND COLLECT PRECIPITATION PLUS SOME FRACTION OF THE PARTICULATE MATTER. THIS GIVES A PARTIAL ESTIMATE OF THE DRY DEPOSITION.

EVENT COLLECTORS OR WET - ONLY COLLECTORS ARE OPEN ONLY DURING PRECIPITATION.

THE AIR QUALITY NETWORKS HAVE A WEAKNESS IN THAT THERE IS NO INSTRUMENTATION WHICH CAN MEASURE THE DRY DEPOSITION ACCURATELY.

HOWEVER, THE LAKES, RIVERS AND WATERSHEDS THEMSELVES ARE THE ULTIMATE "COLLECTORS" OF POLLUTION DEPOSITED FROM THE ATMOSPHERE. ONE RESEARCH APPROACH THAT WE HAVE USED HAS BEEN TO CONSIDER LAKES AND WATERSHEDS AS GIANT DEPOSITION COLLECTORS. THIS CONCEPT IS CALLED "CALIBRATING WATERSHEDS AND LAKES". COMBINATIONS OF WATERSHEDS, STREAMS AND LAKES ARE SUBJECTED TO INTENSIVE MEASUREMENT. THESE CALIBRATED WATERSHEDS ARE THE PRIME SOURCE OF INFORMATION ON THE EFFECTS OF ACID RAIN. OUR MAIN STUDY LOCATIONS ARE NEAR SUDBURY AND DORSET, ONTARIO. HYDROLOGIC GAUGING STATIONS SET UP ON THE INFLOWS AND OUTFLOWS OF LAKES, ALLOW US TO MEASURE THE FLOW OF WATER AND DISSOLVED SUBSTANCES INTO AND OUT OF THE LABS AND WATERSHEDS ACCURATELY. THESE MEASUREMENTS, PERMIT THE CALCULATION OF MASS BALANCES.

COMPARISON OF THE MASS BALANCES WITH THE INPUTS MEASURED AS WET DEPOSITION CAN GIVE ESTIMATES OF DRY DEPOSITION, WHICH IS OTHERWISE VERY DIFFICULT TO MEASURE.

THE CALIBRATED WATERSHEDS ARE SUBJECTED TO DETAILED BIOLOGICAL SAMPLING AND THUS, SERVE TO QUANTIFY THE CHEMICAL AND BIOLOGICAL EFFECTS OF POLLUTANT DEPOSITION. RELATIONSHIPS ESTABLISHED BY DETAILED STUDIES CAN BE EXTRAPOLATED TO LARGE NUMBERS OF LAKES FOR WHICH LESS TOTAL DATA ARE AVAILABLE. EACH STUDY LAKE REQUIRES A GREAT DEAL OF MANPOWER AND FINANCIAL RESOURCES. THIS MEANS, THAT AT ANY GIVEN TIME THE NUMBER OF "DOCUMENTED" CASES OF EFFECTS MEASURED IN CALIBRATED WATERSHEDS IS SMALL. THE

EXTENSIVE NATURE OF THE DAMAGE MUST BE INFERRED BY EXTRAPOLATION.

FOR EXAMPLE, SOME INFORMATION WHICH IS QUITE RELEVANT TO ONTARIO'S ACTION REGARDING THE INCO SMELTER HAS COME FROM CALIBRATED WATERSHED STUDIES NEAR SUDBURY. THE TOTAL SULPHUR DEPOSITION, FOR PARTICULAR WATERSHEDS AS MEASURED BY THE MASS BALANCES IS UP TO 3.5 TIMES GREATER THAN THE FRACTION MEASURED BY BULK COLLECTION (i.e. THOSE OPEN TO THE ATMOSPHERE AT ALL TIMES, HENCE, COLLECTING RAINFALL AND SOME PARTICULATE MATERIAL, BUT NOT GASES). WHOLE LAKE CALCULATIONS HAVE SHOWN THE TOTAL DEPOSITION TO BE FROM 2.5 TO 4.2 TIMES GREATER THAN THE FRACTION MEASURED BY THE BULK COLLECTORS.[1].

THESE RESULTS PROVIDE STRONG EVIDENCE OF THE INTERACTION OF ATMOSPHERIC POLLUTION AND SURFACE WATERS, AND THAT THE LARGE LOCAL SOURCE IS STILL HAVING SIGNIFICANT ENVIRONMENTAL EFFECTS.

SIMILAR STUDIES BEING CONDUCTED ON CALIBRATED WATERSHEDS IN A REMOTE AREA OF NEW YORK INDICATE THAT WHILE TOTAL DEPOSITION OF SULPHATE IS HIGH, THE APPARENT "DRY" COMPONENT, COMING FROM THE INTERACTION OF SULPHUR DIOXIDE AND SURFACE WATERS, IS LOW.[2]

THERE ARE A SERIES OF CALIBRATED WATERSHED STUDIES BEING CONDUCTED IN EASTERN NORTH AMERICA, EACH WITH CAPABILITIES OF MEASURING THE INFLUENCE OF WET AND DRY DEPOSITION FROM THE ATMOSPHERE.

WORK ON OUR LAKES AND STREAMS IS CONTINUING, PARTICULARLY AT DORSET, WITH WATER QUALITY CHANGES AND RESULTING BIOLOGICAL EFFECTS BECOMING BETTER DEFINED. OF COURSE, CONCLUSIONS ARE

T13

CONSTANTLY BEING MADE FROM COMPARISIONS BETWEEN OBSERVATIONS AT DORSET AND OBSERVATIONS AT OTHER LOCATIONS EXPERIENCING ACIDIFICATION OF SURFACE WATERS SUCH AS THE ADIRONDACK MOUNTAINS, SCANDINAVIA AND THE SUDBURY AREA.

AS WE HAVE INDICATED, OUR RESULTS PERTAIN TO ONTARIO, HOWEVER, SIMILAR RESULTS FROM STUDIES IN THE UNITED STATES MUST BE USED IN THE DECISION-MAKING PROCESS BY YOUR AGENCY, JUST AS THEY HAVE BEEN USED BY OUR MINISTRY.

I WILL VERY BRIEFLY TOUCH ON WHAT WE FEEL ARE SOME VERY IMPORTANT OBSERVATIONS REGARDING WATER QUALITY.

IN MOST PARTS OF THE PRECAMBRIAN SHIELD, THE ACIDS ASSOCIATED WITH THE ATMOSPHERIC DEPOSITION OF SULPHATE ARE NEUTRALIZED IN THE WATERSHED DURING MOST OF THE YEAR. RETENTION (NEUTRALIZATION) OF HYDROGEN ION DEPOSITION HAS BEEN MEASURED AT 88% AND 98% ON AN ANNUAL BASIS AT KENORA AND DORSET RESPECTIVELY.[3,4]

HOWEVER, IN SPITE OF THE LOW TOTAL DISCHARGE OF ACID TO THE LAKES, MANY DETRIMENTAL WATER QUALITY EFFECTS ARE BEING OBSERVED. THE HYDROGEN IONS (ACID) STORED IN THE SNOW IS RELEASED IN A SHORT TIME DURING RUNOFF IN THE SPRING THAW AND MOST OF THE TOTAL ANNUAL ACID INPUT OCCURS DURING THE SPRING MELT. THE LARGE VOLUME OF WATER, COUPLED WITH LESS CHANCE FOR INTERACTION WITH THE SOIL, WHICH MAY BE FROZEN, RESULTS IN SHOCK LOADINGS OF ACID TO STREAMS AND TO THE SURFACE WATERS OF LAKES.

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JEFFRIES[5] COMPARED pH VALUES OF A SERIES OF SMALL STREAMS AND LAKE OUTFLOWS AT DORSET BEFORE AND DURING SPRING RUNOFF. (SEE TABLE 1). AT THE VERY MINIMUM, THE SURFACE WATERS OF THE ENTIRE LAKES WERE ACIDIFIED DURING THIS PERIOD OF TIME. THE LOWEST pH VALUES, 4.8 - 5.0, OBSERVED IN LAKE OUTFLOWS, ARE WITHIN A RANGE CAPABLE OF CAUSING DAMAGE TO AQUATIC LIFE, PARTICULARLY TO FISH.[6] AS MUCH AS 75% OF THE MEASURED YEARLY ACID DISCHARGE FROM THE WATERSHEDS RAN OFF IN APRIL. FIGURE 1 SHOWS A TYPICAL HYDROGRAPH FOR ONE OF THESE STREAMS, EMPHASIZING THE HIGH SPRING WATER FLOW, HIGH ACID DISCHARGE, AND LOW pH VALUES.

THERE ARE ABOUT 30 STREAMS UNDER STUDY IN THE DORSET CALIBRATED WATERSHEDS AND SOME HAVE RESULTS FOR A PERIOD OF FIVE YEARS. THE RESULTS FOR THE HARP LAKE WATERSHED PRESENTED HERE ARE TYPICAL OF THE FULL SET OF OBSERVATIONS AND IT CAN BE CONCLUDED THAT ATMOSPHERIC ACID LOADINGS ARE CAUSING PERIODIC WATER QUALITY CHANGES. THE STUDY LAKES ALL HAVE LOW ALKALINITIES AND ARE REPRESENTATIVE OF THOUSANDS OF LAKES IN THE PRECAMBRIAN AREA.

THE DISTRIBUTION OF ALKALINITY DATA FOR A NUMBER OF LAKES THROUGHOUT THE PROVINCE IS SHOWN ON TABLE 2.

THE NUMBER OF LAKES SAMPLED IN EACH AREA TO DATE, IS SMALL IN COMPARISON TO THE TOTAL LAKES IN THESE AREAS, BUT BASED ON THIS DATA IT IS BECOMING CLEAR THAT A VERY HIGH PERCENTAGE OF THE LAKES IN THE ENTIRE PRECAMBRIAN SHIELD FALL IN THE EXTREMELY OR MODERATELY SENSITIVE CATEGORIES.

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IT IS IMPORTANT TO REALIZE THAT THE ALKALINITY VALUES COVER A WIDE RANGE OF VALUES. A CERTAIN NUMBER OF LAKES WILL HAVE THE CAPACITY TO NEUTRALIZE A PARTICULAR ACID INPUT, AND THOSE WITH LESS NEUTRALIZING CAPACITY WILL BE DAMAGED. THE GREATER THE ACID INPUT, THE GREATER THE NUMBER OF LAKES AFFECTED AND THE GREATER THE DEGREE OF DAMAGE LIKELY TO BE CAUSED IN THE AFFECTED LAKES. THEREFORE, WE BELIEVE THAT ALL INCREASES IN ACID LOADINGS WILL BE DETRIMENTAL, WHILE ALL REDUCTIONS WILL BE BENEFICIAL TO SOME DEGREE.

FISH POPULATION DAMAGE IS A MAJOR CONCERN AS IT REPRESENTS LOSS TO THE SPORT FISHING INDUSTRY AND SERIOUS DISRUPTION OF THE BIOLOGICAL FOOD CHAIN SINCE MANY BIRDS AND MAMMALS DEPEND ON FISH FOR FOOD. COMPLETE LOSS OF FISH TENDS TO BE REGARDED AS THE DEFINITION OF A "DEAD" LAKE.

SOME OF THE STUDY LAKES AT DORSET HAVE BEEN SUBJECTED TO INTENSIVE FISH POPULATION MEASUREMENTS AND SEVERAL OBSERVATIONS ARE RELEVANT.

PLASTIC LAKE HAS EXPERIENCED FISH KILLS DURING SNOW MELT WHEN THE pH HAS BEEN AS LOW AS 4.7. FISH CAGING EXPERIMENTS IN THE SPRING OF 1981 HAVE CONFIRMED THE TOXIC CONDITIONS, PARTICULARLY NEAR THE INLET STREAMS, WHERE THE TEST FISH ALL DIED WITHIN TWO DAYS. THE pH AT THE INLET LOCATION WAS AS LOW AS 4.0.[7] THERE WAS NO MORTALITY IN CONTROL STREAMS DURING THE SAME PERIOD WHERE THE pH WAS NEVER MEASURED AT LESS THAN 6.1. SIMILAR EFFECTS HAVE BEEN OBSERVED IN LAKES IN NORWAY AND SWEDEN.[8,9]

WHITE SUCKERS ARE AN IMPORTANT "TEST SPECIES" SINCE THEY ARE NOT SUBJECT TO MUCH DIRECT FISHING PRESSURE AND THEREFORE, CHANGES IN POPULATION ARE MAINLY DUE TO ENVIRONMENTAL EFFECTS.

IN ONE STUDY LAKE, A DISTINCT SHIFT TOWARD A YOUNGER AVERAGE AGE OF WHITE SUCKERS WAS OBSERVED. THIS IS BELIEVED TO BE A CHARACTERISTIC RESPONSE TO LAKE ACIDIFICATION. SIMILAR EFFECTS HAVE BEEN OBSERVED IN NORWAY.[10]

YET ANOTHER STUDY LAKE HAS A YEAR CLASS OF THIS SPECIES MISSING. THIS IS ALSO A CHARACTERISTIC OF LAKES SUBJECT TO ACIDIFICATION DAMAGE.

THESE OBSERVATIONS PROVIDE STRONG EVIDENCE THAT THE FISHERIES ARE BEGINNING TO SUFFER UNDER THE PRESENT ACID LOADING CONDITIONS. IT IS REASONABLE TO ASSUME THAT SIMILAR CHANGES ARE TAKING PLACE IN THE MANY THOUSANDS OF LAKES WITH SIMILAR ALKALINITIES WHICH ARE LIKELY EXPERIENCING SIMILAR WATER QUALITY EFFECTS.

REFERENCES

1. Dillon, P.J., D.S. Jeffries and W.A. Scheider. 1981. The Use of Calibrated Lakes & Watersheds for Estimating Atmospheric Deposition Near a Large Point Source. Conference, American Meteorological Society, Albany, N.Y. April 1981.

2. Galloway, James W., Carl L. Schofield, George R. Hendrey, Elmar R. Altwicker and David E. Trontman, 1981. An Analysis of Lake Acidification Using Annual Budgest. In Ecological Impact of Acid Precipitation. Proceedings of an interactioned conference Sandefjord, Norway, D. Drablos and A. Tollen eds.

3. Scheider, W.A., D.S. Jeffries, and P.J. Dillon. 1979. Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario. J. Internat. Assoc. Great Lakes Res. 5: 45-51.

4. Schindler, D.W., R.W. Newbury, K.G. Beaty and P. Campbell. 1976. Natural Water and Chemical Budgets for a Small Precambrian Lake Basin in Central Canada. J. Fish. Res. Board Can. 33: 2526-2543.

5. Jeffries, D.S., C.M. Cox, and P.J. Dillon. 1979. Depression of pH in Lakes and Streams in Central Ontario During Snow Melt. J. Fish. Res. Board Can. 36: 640-646

6. Beamish, R.J. 1976. Acidification of lakes in Canada by acid precipitation and the resulting effects on fishes. Water, Air and Soil pollution. 6: 501-514.

7. Harvey, H.H. 1981. Interim Report to the Ontario Ministry of the Environment, Cooperative Study of the Toxicity of the Spring Runoff of Plastic Lake, Ontario.

8. Leivestad, H., G. Hendry, I.P. Muniz, and E. Snekvik. 1976. Effects of acid precipitation on freshwater organisms. In Impact of acid precipitation on forest and freshwater ecosystems in Norway. Edited by F. Braekke. Sur Nedbors Virkning Pa Skog og Fisk Rep. 6/76 pp/ 87-111.

9. Hultberg, H. 1977. Thermally Stratified Acid Water in Late Winter - A Key Factor Inducing Self-Acidification. Processes Which Increase Acidification. Water, Air and Soil Pollution 7: 279-294.

10. Rosseland, B.O., I. Sevaldrud, D. Svalastog and I.P. Muniz. 1980. Studies on Freshwater Fish Population - Effects of Acidification on Preproduction Population Structures, Growth and Food Selection In Proc. Int. Conf. Ecological Impact Acid Precipitation, Norway. 1980. SNSF Project D. Drablas and A. Tollan, Editors 9:336-337

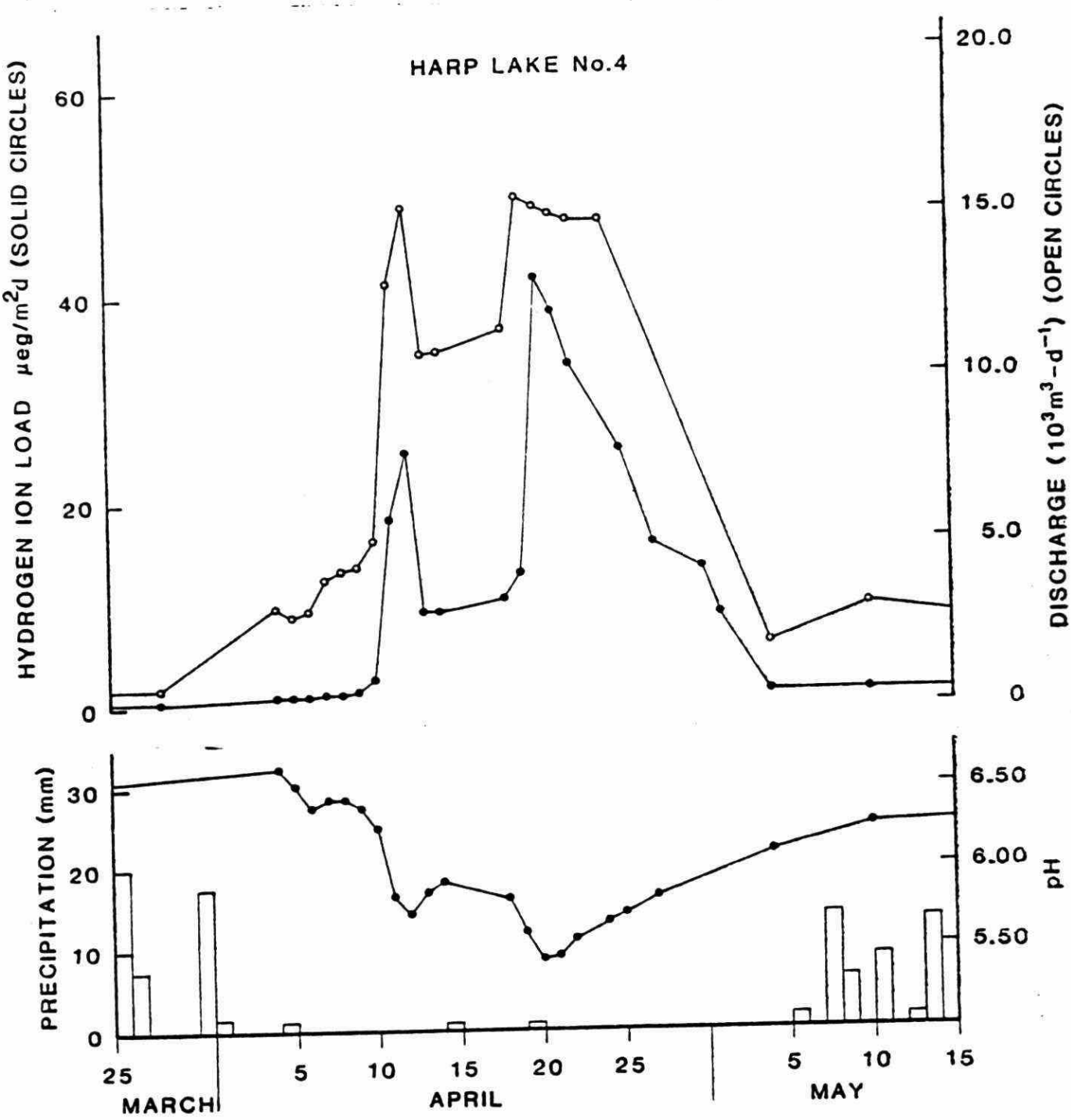

Figure 1: "Spring pH Depression" of a Stream
Graph illustrating "spring pH depression" in one of the six inflowing streams to Harp Lake, a study lake in Muskoka. As the spring runoff increases the amount of water, the acidic melted snow causes the stream pH to drop, producing severe chemical "shock" effects on aquatic life.

TABLE 1

pH OF STREAMS IN MUSKOKA-HALIBURTON, ONTARIO, CANADA: STREAM pH IS GIVEN PRIOR TO SPRING RUNOFF (MID-MARCH 1978) AND AT MAXIMUM RUNOFF (MID-APRIL 1978)

Annual Average Alkalinity data from Scheider (Pers. Comm)

Watershed	Annual Average Alkalinity µeq/l	Stream Number	pH	
			Mid-March	Mid-April
Harp Lake	96	3	6.1	5.1
		3A	6.0	5.6
		5	5.9	4.8
		6	6.2	5.3
		6A	5.4	5.0
		Outflow	6.3	5.0
Dickie Lake	55	5	4.6	4.3
		6	4.6	4.4
		11	4.9	4.1
		Outflow	5.6	4.9
Chub Lake	61	1	5.8	5.1
		2	5.2	4.7
		Outflow	5.5	4.8
Red Chalk Lake	92	1	6.1	5.6
		2	4.5	4.3
		3	6.0	5.5
		4	6.2	5.5
		Outflow	6.1	5.9

Partial Table From: Jeffries et al., 1979

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TABLE 2 SUMMARY OF THE PERCENTAGE OF LAKES IN EACH ALKALINITY CLASS BY COUNTY OR DISTRICT

County or District	Percentage of Total No. of Lakes in each Alkalinity Class					
	Acidified (≤ 0 µeq/l)	Extreme Sensitivity (>0 to 39.9 µeq/l)	Moderate Sensitivity (40 to 199 µeq/l)	Low Sensitivity (200 to 499 µeq/l)	Not Sensitive (≥ 500 µeq/l)	Total No. of Lakes Surveyed In County District
Algoma District	5	11	30	28	26	163
Bruce Co.					100	7
Cochrane Dist.		7		11	82	27
Durham Co.					100	1
Frontenac Co.				6	94	64
Grey Co.					100	3
Haliburton Co.		24	39	22	15	112
Hastings Co.			21	11	68	63
Huron Co.					100	1
Kenora Dist.			14	25	61	88
Lanark Co.					100	15
Leeds Co.					100	24
Lennox & Addington Co.			36	12	52	25
Manitoulin Dist.	52	29	3	3	13	31
Middlesex Co.					100	1
Muskoka Dist.	1	30	61	2	6	115

. . .continued/

TABLE 2 SUMMARY OF THE PERCENTAGE OF LAKES IN EACH ALKALINITY CLASS BY COUNTY OR DISTRICT

County or District	Percentage of Total No. of Lakes in each Alkalinity Class					
	Acidified (≤ 0 µeq/l)	Extreme Sensitivity (>0 to 39.9 µeq/l)	Moderate Sensitivity (40 to 199 µeq/l)	Low Sensitivity (200 to 499 µeq/l)	Not Sensitive (≥ 500 µeq/l)	Total No. of Lakes Surveyed In County/ District
Nipissing Dist.		9	75	13	3	75
Northumber-land Co.					100	1
Ontario Co.					100	5
Parry Sound Dist.	5	20	64	10	1	107
Peel Co.					100	1
Peterborough Co.		4	16	6	74	49
Prince Edward Co.					100	3
Rainy River Dist.		3	64	19	14	99
Renfrew Co.			8	32	60	50
Simcoe Co.					100	7
Stormont Co.					100	1
Sudbury Dist.	24	29	23	12	12	210
Thunder Bay Dist.	1	.2	25	27	45	136
Timiskaming Dist.	13		7	27	53	30
Victoria Co.					100	11
York Co.					100	2
						1,527

REMARKS BY DR. G. VAN VOLKENBURGH

WHAT MODELLING TELLS US ABOUT ONTARIO, NEW YORK AND PENNSYLVANIA TRANSBOUNDARY AIR POLLUTION

1. INTRODUCTION:

Until a few years ago, we were primarily concerned with air quality in the vicinity of a pollutant source. Concentrations were considered high, if they were above levels determined to be harmful to plants and human health. Using this criterion, even large pollutant sources could be considered to have little effect beyond distances of the order of tens of kilometers from the source. This way of looking at pollution ignored the effects of the large fraction of the emission which left this region of "local" air quality effects.

It is to be noted that applying the conventional short range models recommended by EPA, all the pollutants escape to greater distances, although in small concentrations. If we apply dry and wet deposition to the plume, then approximately 30 - 90% of the pollutants would escape to greater distances depending on stack height. This is assuming that 10% of the time the plume encounters precipitation at the release point.

It is only recently that we have become aware of the cumulative effect of small concentrations from a large number of sources. Secondary pollutants from several sources can be high at distances of hundreds of kilometers from the source region. Furthermore, the occurence of acid rain has forced us to redefine the meaning of "high" as applied to local air quality.

Analysis of meteorology during high TSP episodes has shown the role of long-range transport. Mathematical modelling has also indicated the extent of pollution caused by long range transport. These models also determine the source-receptor relationships and develop emission control strategies.

2. MODELLING ISSUES

a. What is a LRT model?

A LRT model is a description of the relevant physical system in the precise language of mathematics. Physical relationships in the system are replaced by logical mathematical connections or equations. Cause-effect relationships can be investigated by routine manipulation of equations. Since the physical system is extremely complex, this description or model is necessarily incomplete. Models attempt to include variables which control the physical system.

b. What does a model predict?

In theory, a perfect model is possible. In practice, this is impossible because even if we had all the equations to describe the system, we would not have the information to run the model. Specifically, we could predict the fate of released particles if we had the velocity field completely specified at all points in space and time. This is clearly impossible. Consider the fact that wind monitors are spaced at typical distances of tens of kilometers. This means that we do not know the velocity field between the monitors. This lack of information prevents us from predicting the concentration field corresponding to the precise time interval the velocities are measured. Then what does a model predict?

Models are designed to predict the average over the concentrations corresponding to the model inputs. In a long-range transport model these inputs typically consist of velocities, mean and their statistics, precipitation and mixed layer height. Since these inputs do not constitute all the information needed to estimate the observed concentration, we expect the model prediction to deviate from an observation.

c. How do you use model results?

Model predictions are expected to deviate from corresponding observations. The expected deviation is a function of averaging time. It decreases as the averaging time increases. In other words, the deposition at a receptor averaged over five years will deviate less from the model prediction than one year average will. What does the model tell us if the emission from a source is reduced? A reduction in emission increases the probability that the deposition will be below a given target value. The model cannot tell you whether the actual deposition with the new emission rate will be below that corresponding to the old emission rate. Decisions have to be based on probability rather than certainty. As an example, consider the automobile speed limit. We reduce the speed so that the probability that accidents occur decreases. Clearly,

we do not expect this decrease in speed limit to result in a decrease in the accident rate on the first day after the new speed limit is posted. On the other hand, it is reasonable to expect a decrease over a period of months.

d. Long-range transport modelling:

The effect of a single large source is "small" at large distances from the source. However, the cumulative effect of a large number of sources can be large. This is the crux of the long-range transport problem. This means that the small contribution from a source area is important relative to other small contributions. To be specific, consider 20 sources, each of which contributes 5% to the deposition at a sensitive area. If the total deposition is 2g m^{-2} yr^{-1}, each source contributes only 0.1g $m^{-2}yr^{-1}$. Under these circumstances, we have to assume that all the sources are equally guilty of causing the problem. A doubling of any one source doubles the culpability of the source relative to the other sources. The deposition at the receptor would become 4g m^{-2} yr^{-1} if all the sources decided to double their emissions.

3. MOE MODEL

Let me describe to you the model used in our submission and

some typical outputs of this model. The model (Venkatram et al 1981) is statistical in nature and simple. The only inputs required by the model are emission fields and receptor points.

The model has three components, transport and dispersion, wet and dry scavenging, and chemistry. Transport and dispersion, is treated in a simple manner by prescribing the distribution of pollutants, inside a long-range, long-term plume with respect to a source. Linear chemistry is incorporated, due mainly to the lack of sufficient knowledge on non-linear chemistry. Wet and dry scavenging is treated in a unique manner by assuming a puff, released from the source, to encounter wet period and dry periods in a statistical sense. The model uses a background of 0.2 $g/m^2/yr$ of wet deposition of sulphur. The background is attributed to biogenic sources and sources not accounted for in the model.

The model has been extensively reviewed by peers in the field and has been accepted for publication in an international journal, Atmospheric Environment. This attests to the merits of the model.

4. Results

1. The first transparency shows the distribution sources in the inventory used in the model. The inventory is based on EPA's point source inventory compiled by Benkowitz of BNL from the NEDS and point and area source inventory of GCA. The Canadian sources are obtained from the AES, Canada and MOE inventories.

All large ($\geq$ 100 K Tonnes/yr) point sources and 95% of major ($\geq$ 10k Tonnes/yr) point sources were incorporated into the model's inventory to form effective point sources located at the emission-weight geometric means of the co-ordinates of the contributing points. Care was taken to amalgamate only sources situated in similar geographic settings and, in general, less then 50 Km apart. Approximately 60% of all area sources and 72% all minor point sources were incorporated into the inventory adding minor point sources and area sources located near ($\lesssim$ 50km) major points to that point or combining small sources concentration in large urban centers to form effective point sources.

2. The 2nd transparency shows the isopleths of total wet deposition of Sulphur as predicted by the model. Note that they are all long term averages. The circles denote monitor locations, the large numerals being monitor codes.

3. The 3rd transparency shows the validation of model predictions of total wet sulphur deposition with observed data.

A background value of .2g/m^2/yr has been added to the model predictions to account for sources which have not been considered in the inventory and biogenic sources such as sea spray, volcanoes etc. The geometric mean and standard deviation of the observed minus predicted is 1.16 and 1.64 attesting to the validity of the model. The "ideal" value of m_g is unity.

4. The 4th transparency shows isopleths of $SO_4^=$ air concentrations predicted by the model.

5. The 5th transparency shows validation of the model predictions for $SO_4^=$ concentration. A back ground value has not been added here as we don't yet know what this background value is. Nevertheless the comparison between the model predictions and observed data is quite good. If we add a background value of 1.9 $\mu g/m^3$ the geometric mean and standard deviation becomes .99 and 1.4.

6. The 6th transparency shows the isopleths of SO_2 air concentration predicted by the model. In view of the fact that monitors for ambient SO_2 concentration are not strictly free of local source effects we have not validated the model as yet for SO_2. The levels of SO_2 concentrations are reasonable.

7. The 7th transparency shows the relative contribution of SO_2 to total wet sulphur deposition. This large contribution is attributed to rapid incloud oxidation of SO_2 to $SO_4^=$. This insitu formation of $SO_4^=$ leads to efficient washout of SO_2. It is noted that SO_2 is efficiently dry deposited too. SO_4 however, is not dry deposited efficiently.

8. The 8th transparency shows a list of 20 power plants cited in the NY submission.

9. The 9th transparency shows the results of the contribution of these 20 power plants. The first column shows the magnitudes of total wet deposition of sulphur to the 6 sensitive receptors. The other 4 columns show the percentage contributions from 1979 emission levels of the 20 sources, the decrease in percent if 1979 actual emissions were reduced to 1979 SIP maximums, percent increase if emissions rise from 1979 SIP max. to proposed maximum respectively.

10. The 10th transparency shows the results of the contribution of these 20 power plants to the SO_4 air concentration.

The 1st column shows the magnitudes of long term average SO_4 concentration to the 6 sensitive receptors. Columns 2-5 show the percentage contributions from 1979 emission levels of the 20 sources, the decrease in percent if 1979 actual emissions were reduced to 1979 SIP maximums, percent increase if emissions rise from actual 1979 levels to proposed new limits, and percent increase if emissions rise from 1979 SIP maximums to proposed maximums respectively.

11. The 11th transparency shows the results of the contribution of these 20 power plants on air concentration of SO_2.

The 1st column shows the magnitudes of long-term average SO_2 concentration to the 6 senstive receptors. Columns 2-5 show the percentage contributions from 1979 emission level of the 20 NY sources, the decrease in percent if 1979 actual emissions were reduced to 1979 SIP maximums, percent increase if emissions rise from actual 1979 levels to proposed new limits, and percent increase if emissions rise from 1979 SIP maximums to proposed maximums respectively.

12. The 12th transparency shows the 53 sources cited by Pennsylvania and N.Y. in the Federal Register.

13. The 13th transparency shows the magnitude of total annual wet deposition of sulphur at the 6 sensitive receptors and the percent contribution by the 53 sources cited by Penn. and N.Y.. Also shown is a breakdown of contributions from other sources.

I wish to note that the emissions from INCO used in these calculations were 1600 short tons/day. Previous speaker have intimated that the tonage from INCO is 3600 short tons/day and this is a distortion of the actual situation. In actual fact the current regulated maximum emission level of INCO is 2500 short tons/day and because of strikes and shut-downs during the 1978 and 1979 period the average daily level for these years was less than 1600 short tons/day.

The confusion about emission inventories does not help any of us discuss the issues of transboundary pollution in a clear manner.

14 The 14th transparency presents the magnitude of the long-term average SO_4 concentration at the six receptors and the percent contribution by the 53 sources. The contribution from other sources is also shown.

15. The 15th transparency presents the magnitude of the long-term average SO_2 concentration at the six sensitive receptors and the percent contribution by the 53 sources. Also the contribution from other sources is shown.

5. SUMMARY OF RESULTS

These results have shown the percentage contributions to the sensitive receptors for various source configurations. In view of the fact that the model predicts an average value we should not expect that a single year's observation would agree with this prediction.

The issue before us is the magnitude of increase in pollutant concentration due to an increase in emission levels. There is no simple answer to this problem. The problem can be traced to the extremely complex nature of turbulent flows which have not been amenable to a simple solution. The importance of this question has currently been brought to the forefront and several workshops (Woodshole Workshop, Work Group II workshops) have been held on this subject. It is the consensus of the scientists globally that more work is needed to resolve this problem. For the moment the verification techniques are being standardised and the criteria of validation of models are being formulated.

6. DECISION MAKING

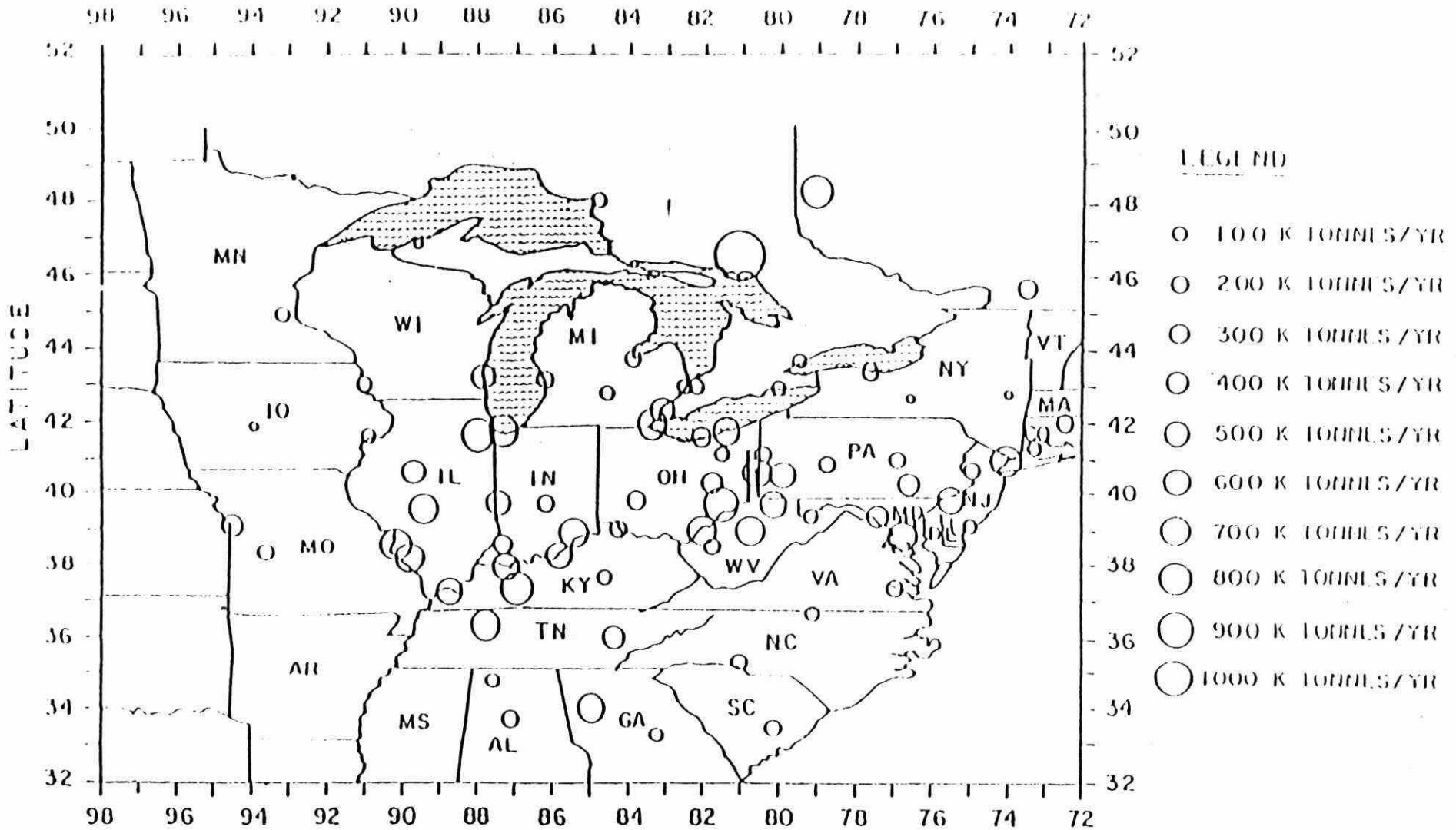
I would like to bring to the notice of the panel some other areas where decisions are made regularly in spite of the uncertainties in the data. For example, no one can predict precisely the formation of tornadoes in space and time. Yet, living quarters are built regularly. Dams are constructed from a subset of data on water flows in rivers. Crops are planted in spite of the uncertainties in weather. Economic decisions are made daily on econometrics models in spite of their uncertainties.

We recognize that increase in sulphur deposition is going to damage the ecosystem in the sensitive areas. We also recognize that there are uncertainties in models and that expectations that perfect models would be available in the near future are unrealistic. Let me ask you, can we afford not to react now with the available information however uncertain it may be?

Precedents exist in the abatement area where decisions have been made on model results. For example, use of freon in spray cans has been banned on model results that freon released from these cans would upset the O_3 layer. Therefore, we should not be afraid to act now and base decisions on models even if air quality models today lack the precision that we would all like them to have.

Conclusions:

In my presentation today I have described the model in relation to the terms of reference of the hearing. We have used the model for Ontario for emission control. Mr. Scott, the next speaker, will discuss the way in which these results have been used.



SOURCES OFF THE MAP

EMISS	SOURCE NAME	LAT	LONG	EMISS	SOURCE NAME	LAT	LONG
O	PORTLAND – AUGUSTA	43·4	71·0	O	FLIN FLON MAN	54·9	101·0
O	BOSTON-WORCESTER	40·3	71·3	O	MONCTON N.B.	45·5	66·0
O	NEWPORT-FALL RIVER	41·7	71·1	o	NOVA SCOTIA	45·0	62·8

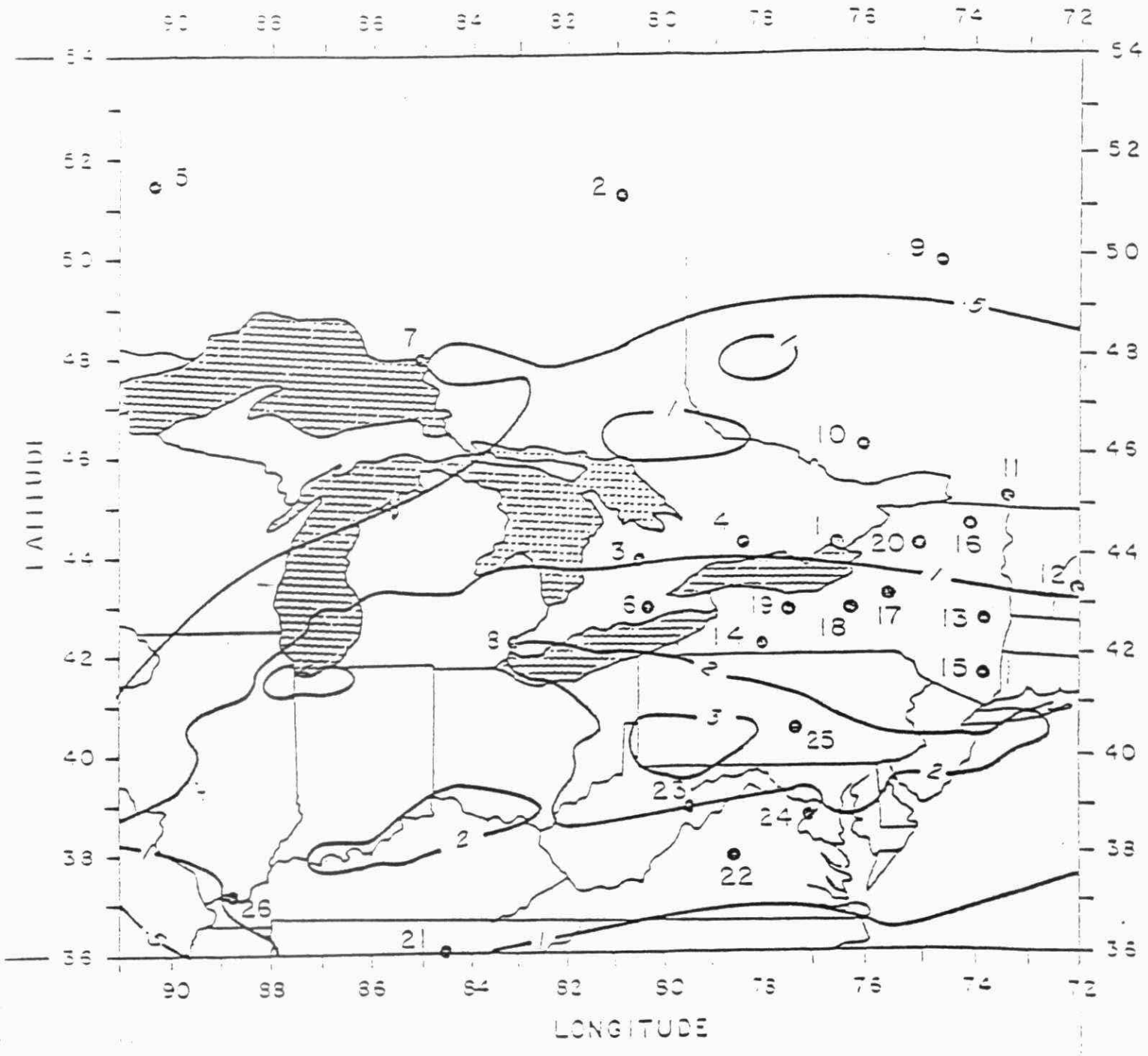


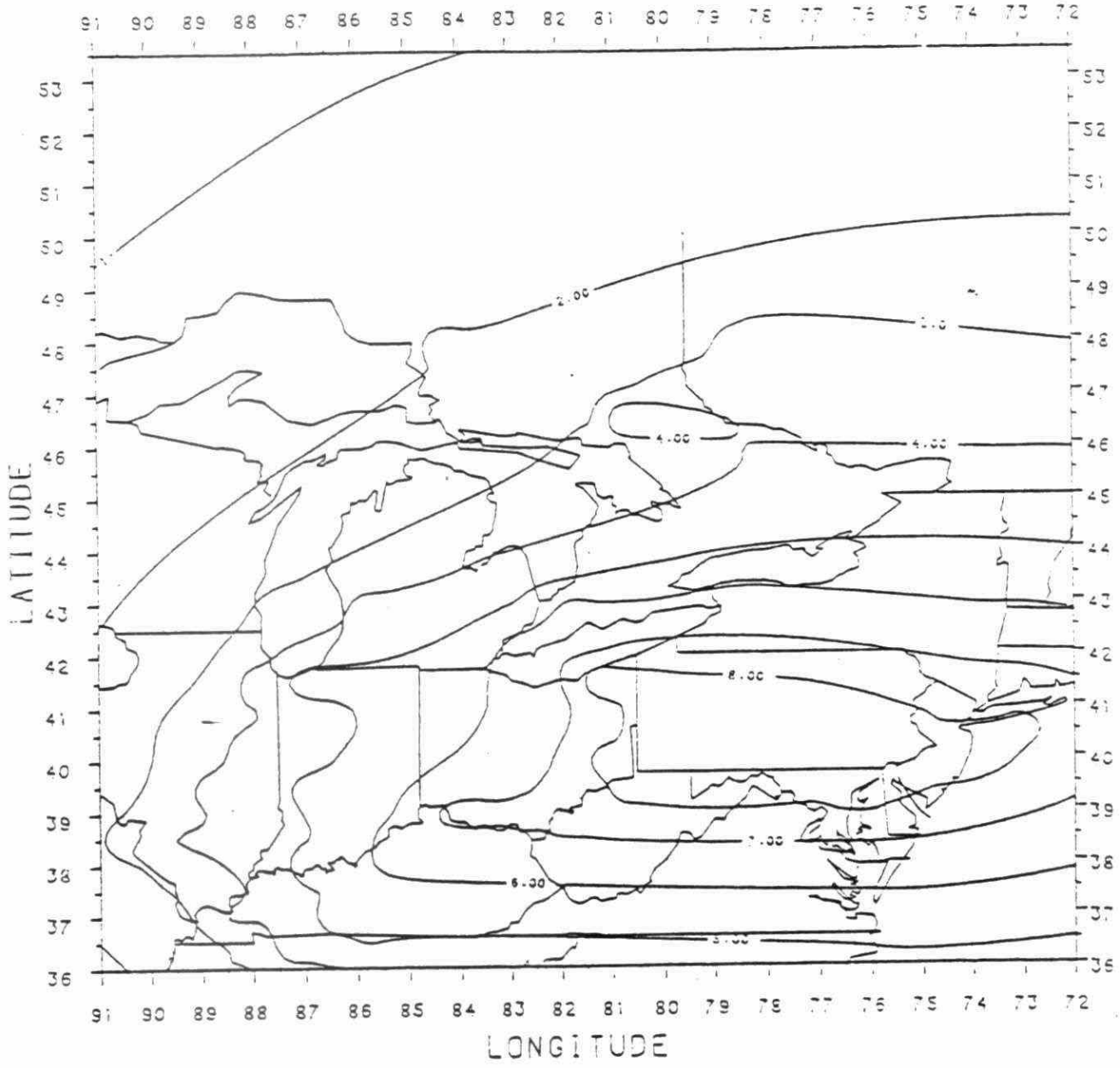
FIGURE 3: Model predictions of annual wet deposition of sulfur in $gr/m^2/a$. Stars in figure correspond to monitors in the EMEP and U.S. networks. Numbers next to stars are station codes referred to in Table 2.

Total Annual Wet Deposition of Sulphur Comparison of Observed OME Model Estimate

Station No.	Receptor Name	OBS ($gm^{-2}a^{-1}$)	PRED ($gm^{-2}a^{-1}$)	OBS/PRED
1	Kingston, Ont.	1.26	0.93	1.35
2	Moosonee, Ont.	0.58	0.33	1.76
3	Mount Forest, Ont.	2.32	0.96	2.42
4	Peterborough, Ont.	1.81	0.94	1.93
5	Pickel Lake, Ont.	0.39	0.28	1.39
6	Simcoe, Ont.	2.34	1.49	1.57
7	Wawa, Ont.	0.91	0.52	1.75
8	Windsor, Ont.	2.98	2.00	1.49
9	Chibougamau, Que.	1.06	0.42	2.52
10	Maniwaki, Que.	0.71	0.75	0.95
11	Montreal, Que.	2.35	0.88	2.67
12	Merrimach Cnty, N.Y.	0.91	0.93	0.98
13	Albany Cnty, N.Y.	1.20	1.21	0.99
14	Allegany Cnty, N.Y.	2.20	1.58	1.39
15	Dutchess Cnty, N.Y.	1.20	1.48	0.81
16	Essex Cnty, N.Y.	0.84	0.84	1.00
17	Oneida Cnty, N.Y.	1.70	1.08	1.57
18	Onondaga Cnty, N.Y.	0.79	1.19	0.66
19	Ontario Cnty, N.Y.	1.20	1.34	0.90
20	St. Law. Cnty, N.Y.	1.00	0.89	1.12
21	Oak Ridge, Tenn.	1.30	1.04	1.25
22	Charlottesville,Vir.	0.91	1.31	0.69
23	Tucker Cnty, W.V.	2.00	1.94	1.03
24	Washington, D.C.	1.00	1.83	0.55
25	Lewistown, Penn.	0.98	2.21	0.44
26	Paducah, Kentucky	0.57	1.29	0.44

LINEAR ANALYSIS: OBSERVED DEPOSITION = a - b * PREDICTED DEPOSITION

Receptor Location	r^2	a($g.m^{-2}/gm^{-2}$)	b	Receptor Excluded
Canada	0.76	0.24	1.49	
Canada	0.84	0.16	1.48	11
U.S.	0.09	0.73	0.84	
U.S.	0.47	0.05	0.98	24, 25, 26
All PT	0.19	0.67	0.68	
All PT	0.61	0.24	1.04	11, 24, 25, 26
All PT Can Obs Reduced 30%	0.70	0.12	0.97	11, 24, 25, 26



Long term average $SO_4^=$ concentration (assuming no background) contoured in 1 $\mu g/m^3$ intervals. Calculated using the CAMP long-range statistical model.

Long-term Average $SO_4^=$ Concentrations

Intercomparison of MOE statistical Model, estimate of Annual average $SO_4^=$ concentrations with annual average concentrations at the 9 Class I SURE Phase II stations for different averaging times:

Station	Avg. Observed Concentrations* (microgram/m^3)			Model Estimate (microgram/m^3)
	(1)	(2)	(3)	
1. Montague, Amherst MA (72.6, 42.38)	3.3	5.6	5.2	6.4
2. Scranton, Scranton PA (75.70, 41.40)	7.9	7.8	7.4	7.6
3. Indian R., Millsboro DE (75.30, 38.58)	7.0	6.9	6.7	7.2
4. Philo, Janesville OH (82.0, 39.92)	9.2	8.3	7.5	7.6
5. Rockport, Owensboro KY (87.1, 37.75)	9.5	8.2	7.8	5.0
6. Giles City, Huntsville AL (86.6, 34.7)	8.9	8.4	8.2	2.5
7. Ft. Wayne, Ft. Wayne IN (85.2, 41.08)	8.2	7.8	7.5	5.4
8. Chapel Hill, Raleigh NC (78.7, 35.75)	7.6	7.6	7.5	4.4
9. Lewisburg, Lewisburgh WV (80.45, 37.8)	7.7	8.0	7.7	6.3

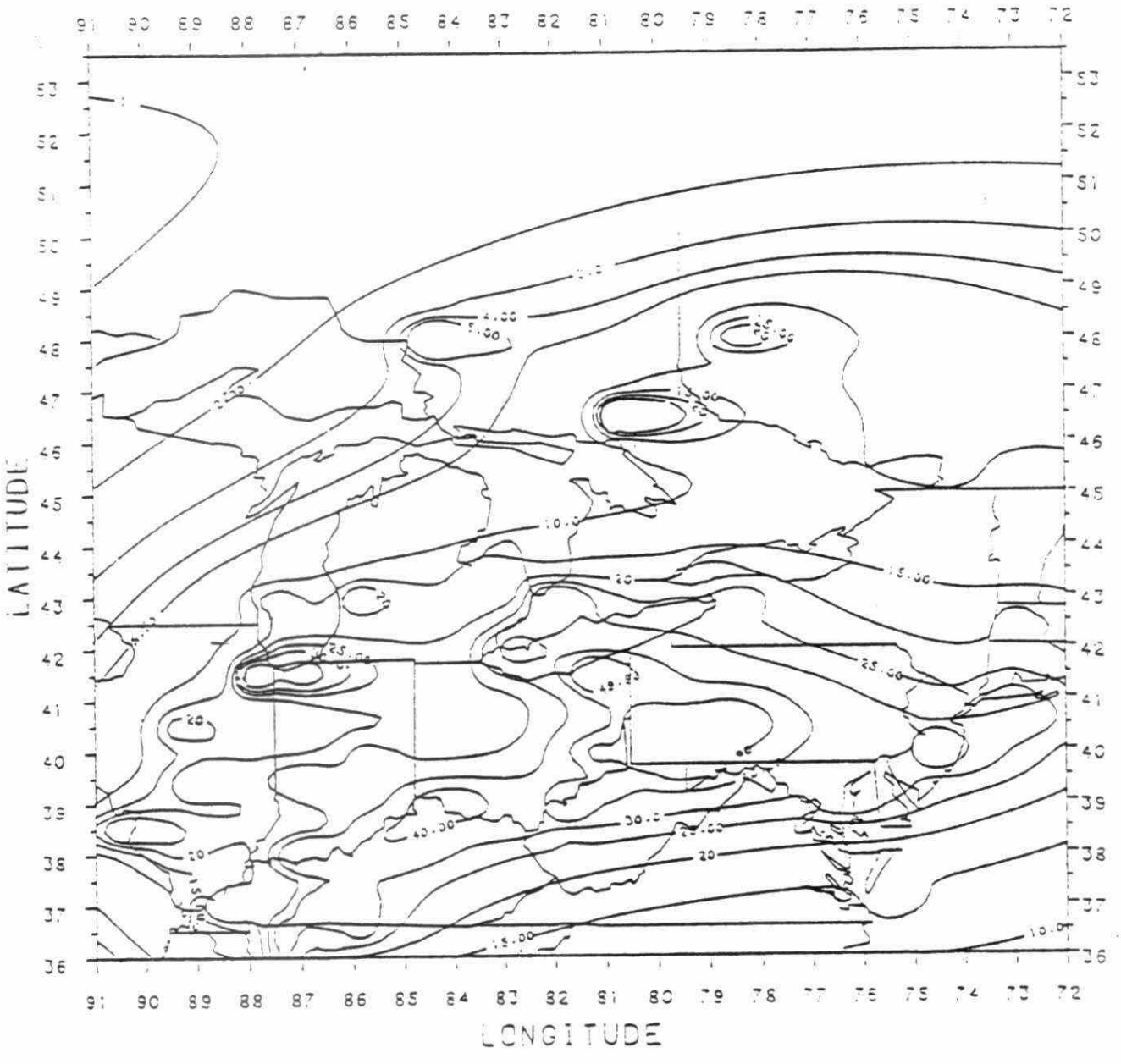
Averaging time:

(1) August 1977 - July 1978

(2) November 1977 - October 1978

(3) August 1977 - June 1978

* B.L. Niemann (1980)



Long term average SO_2 concentration (assuming no background) contoured in 5 $\mu g/m^3$ intervals. Calculated using the OME long-range statistical model.

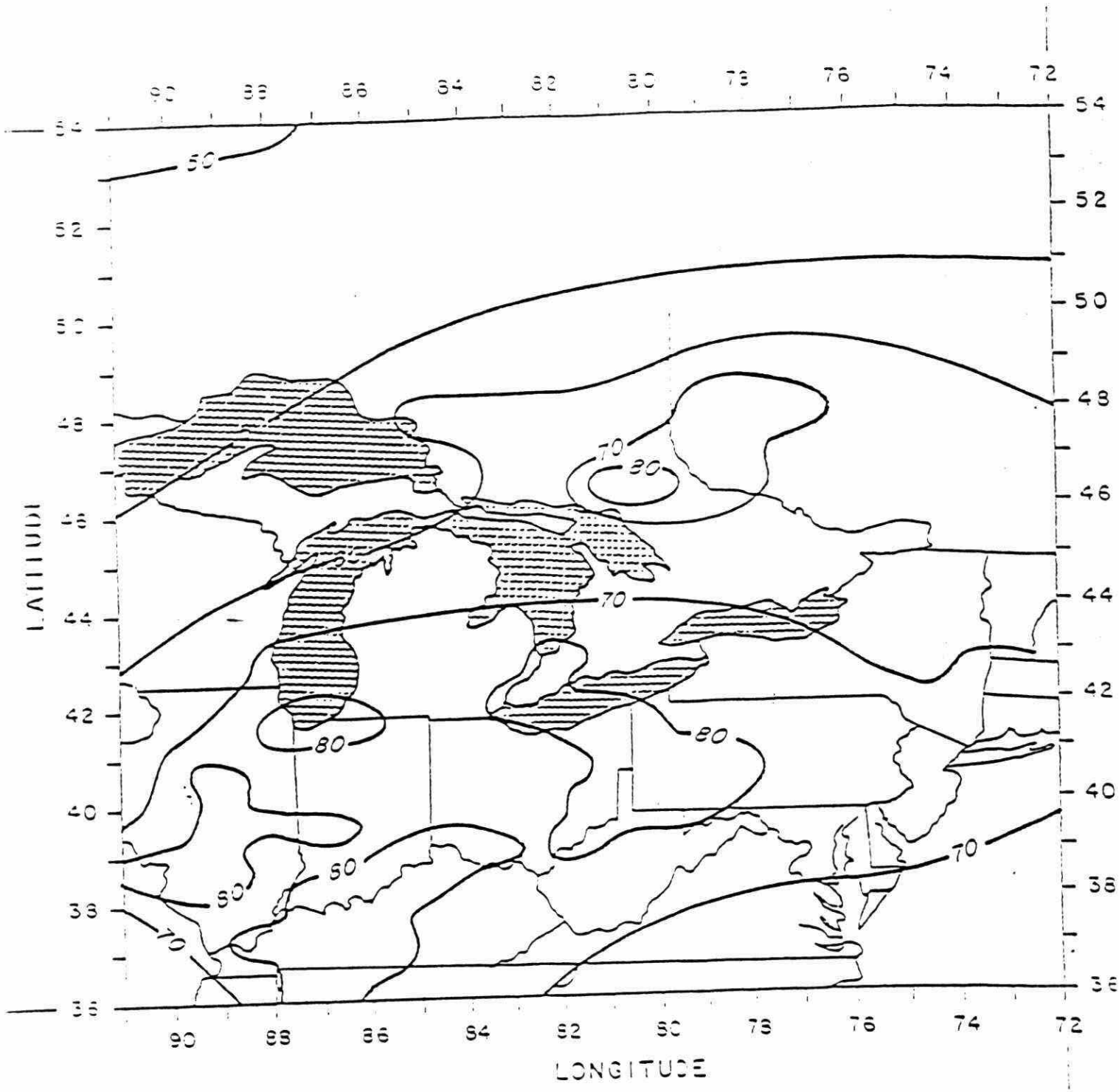


FIGURE 4: Relative contribution of SO_2 to the total wet deposition of sulfur.

TABLE 2: U. S. Coal-Burning Power Plants Proposing an Increase in their SO_2 Emission Limits

NOTE: All figures are in thousands of metric tons.

STATE Power Plant	Amount Allowable Under 1979 Regulation	Proposed Increase in Emissions Above Regulation	Proposed Total Emission	Estimated 1979 SO_2 Emissions
ILLINOIS				
1) Baldwin	228.7	54.4	283.1	257.9
INDIANA				
2) Clifty Creek	46.2	174.5	220.7	263.7
3) Tanners Creek	26.1	116.6	142.7	85.2
4) Michigan City	17.0	84.1	101.1	62.4
5) Culley	12.5	50.4	62.9	61.3
6) Bailly	13.9	46.6	60.5	58.0
7) Stout, Elmer W.	17.6	72.2	89.8	44.2
8) Warrick	4.3	111.7	116.0	20.2
9) Mitchell, Dean H.	13.6	62.2	75.8	19.2
MICHIGAN				
10) Cobb	40.3	20.2	60.5	69.3
11) Campbell	39.2	19.5	58.7	57.0
OHIO (I)				
12) Muskingum	235.0	150.5	385.5	340.2
13) Cardinal	214.1	68.6	282.7	140.8
14) Beckjord	136.0	9.2	145.2	99.7
15) Poston	16.3	16.3	32.6	29.1
16) Bayshore	19.3	16.2	35.5	23.7
TENNESSEE				
17) Kingston	51.0	90.2	141.2	87.2
WEST VIRGINIA				
18) Kammer	63.6	157.3	220.8	136.8
OHIO (II)				
19) Avon Lake	26.0	111.4	137.4	88.2
20) East Lake	36.5	131.4	167.9	137.4
TOTAL	1257.2	1563.5	2820.7	2091.5

Contributions of wet sulphur deposition from 20 U.S. power plants including Avon Lake and Eastlake under various emissions cases to environmentally sensitive areas in Canada and the U.S.

Note: Each column presents data connected with the plants' emissions, as described. Where noted, the data are expressed as wet deposition percentages, with the normalizing factor being the total wet deposition occuring in 1979 due to actual emissions from all sources. This is the data listed in the first column.

Note: Model predictions have been verified to be accurate within a factor of 2 with 60% of estimates within 95% of expected values.

Sensitive Region	Total Wet Sulphur Deposition $g/m^2/yr.$	Per Cent Amount due to actual 1979 emissions	Per Cent Decrease occuring if 1979 actual emissions were reduced to 1979 SIP maximums.	Per Cent Increase occuring if emissions rise from actual 1979 levels to proposed new limits	Per Cent Increase occuring if emissions rise from 1979 SIP max to proposed max.	Per Cent Amount due to emissions if they are held at 1979 SIP limits (Column 1 minus 2)	Per Cent Amount due to emissions if they rise to proposed new limits (Column 1 plus 4)
Muskoka-Haliburton, Ontario	0.67	4.5	2.0	1.4	3.4	2.5	5.9
Algoma, Ontario	0.47	3.0	1.3	0.9	2.2	1.7	3.9
Lakehead, Ontario	0.28	1.9	0.8	0.7	1.4	1.1	2.6
Val D'Or, Quebec	0.61	2.7	1.1	0.8	2.0	1.6	3.5
Adirondacks, N.Y.	0.83	5.5	2.3	1.9	4.3	3.2	7.4
West Pennsylvania	1.94	11.4	3.4	5.0	8.5	8.0	16.5

710

Contributions to $SO_4^=$ Concentration from 20 U.S. Power Plants listed by New York to Environmently Sensitive Areas in Canada and the U.S.

Note: Each column presents data connected with the plants' emissions, as described. Where noted, the data are expressed as $SO_4^=$ concentration percentages, with the normalizing factor being the total $SO_4^=$ concentration occuring in 1979 due to actual emissions from all sources. This is the data listed in the first column.

Sensitive Region	Long-term Average $SO_4^=$ Concentration (micrograms/m^3)	Per Cent Amount due to actual 1979 emissions	Per Cent Decrease occuring if 1979 actual emissions were reduced to 1979 SIP maximums.	Per Cent Increase occuring if emissions rise from actual 1979 levels to proposed new limits	Per Cent Increase occuring if emissions rise from 1979 SIP max to proposed max.	Per Cent Amount due to emissions if they are held at 1979 SIP limits (Column 1 minus 2)	Per Cent Amount due to emissions if they rise to proposed new limits (Column 1 plus 4)
Muskoka-Haliburton, Ontario	3.43	7.5	3.2	2.5	5.7	4.3	10.0
Algoma, Ontario	2.13	6.9	2.9	2.2	5.1	4.0	9.1
Lakehead, Ontario	0.98	7.2	3.0	2.4	5.4	4.2	9.6
Val D'Or, Quebec	2.76	6.2	2.6	2.1	4.7	3.6	8.3
Adirondacks, N.Y.	4.59	7.9	3.3	2.7	6.0	4.6	10.6
West [illegible]	7.[illegible]	[illegible]	[illegible].0	[illegible].3	8.3	7.1	15.4

Contribution to SO_2 Concentration from 20 U.S. Power Plants listed by New York to Environmently Sensitive Areas in Canada and the U.S.

Note: Each column represents data connected with the plants' emissions, as described. Where noted, the data are expressed as SO_2 concentration percentages, with the normalizing factor being the total occuring in 1979 due to actual emissions from all sources. This is the data listed in the first column.

Sensitive Region	Long-term Average SO_2 Concentration (micrograms/m^3)	Per Cent Amount due to actual 1979 emissions	Per Cent Decrease occuring if 1979 actual emissions were reduced to 1979 SIP maximums.	Per Cent Increase occuring if emissions rise from actual 1979 levels to proposed new limits	Per Cent Increase occuring if emissions rise from 1979 SIP max to proposed max.	Per Cent Amount due to emissions if they are held at 1979 SIP limits (Column 1 minus 2)	Per Cent Amount due t emissions if they rise to proposed new limits (Col ... plus 4)
Muskoka-Haliburton, Ontario	7.86	5.9	2.6	1.8	4.4	3.3	7.7
Algoma, Ontario	4.40	4.3	1.9	1.3	3.2	2.4	5.6
Lakehead, Ontario	0.96	6.0	2.5	2.0	4.5	3.5	8.0
Val D'Or, Quebec	6.98	3.1	1.3.	1.0	2.3	1.8	4.1
Adirondacks, N.Y.	10.64	6.9	2.9	2.5	5.4	4.0	9.4
West Pennsylvania	33.35	12.9	3.8	5.8	9.6	9.1	18.9

TABLE 1

Sources listed by the "Federal Register"* and "Inside EPA"** cited by Pennsylvania and New York for the Proceedings under Section 126

			Emission (10^3 tonnes SO_2/yr)
N	KINCAID	ILLINOIS	136.3
P	CAVIN	OHIO	339.5
P	KYGER CREEK	OHIO	205.5
P	CONSVILLE	OHIO	186.8
P	SAMMIS	OHIO	160.7
P	BURGER	OHIO	79.0
P	NILES	OHIO	30.9
P	TORONTO	OHIO	29.6
P	MITCHELL	W. VIRGINIA	186.2
P	HARRISON	W. VIRGINIA	142.8
N	BALOWIN	ILLINOIS	257.9
N	CLIFTY CREEK	INDIANA	263.7
N	TANNERS CREEK	INDIANA	85.2
N	MICHIGAN CITY	INDIANA	62.4
N	CULLEY	INDIANA	61.3
N	BAILLY	INDIANA	58.0
N	STOUT, ELMER W,	INDIANA	44.2
N	WARRICK	INDIANA	20.2
N	MITCHELL, DEANH	INDIANA	19.2
N	COBB	MICHIGAN	69.3
N	CAMPBELL	MICHIGAN	57.0
NP	MUSKINGUM	OHIO	340.2
NP	CARDINAL	OHIO	140.8
N	BECKJORD	OHIO	99.7
N	POSTON	OHIO	29.1
N	BAYSHORE	OHIO	23.7
N	KINGSTON	TENNESSEE	87.2
NP	KAMMER	W. VIRGINIA	136.8

P	FED PAPER	OHIO	1.9
P	TORONTO PAPER	OHIO	50.9
P	NSC WEIRTON	OHIO	0.2
P	NORTH	OHIO	4.8
P	SOUTH	OHIO	3.7
P	YORKVILLE	OHIO	3.1
P	MARTIN'S FERRY	OHIO	1.1
P	ALLIED CHEMICAL	W. VIRGINIA	1.1
P	BANNER FIREBORD	W. VIRGINIA	0.4
P	NSC WEIRTON	W. VIRGINIA	80.9
P	GLOBE REFRACT	W. VIRGINIA	3.0
P	KOPPER	W. VIRGINIA	4.4
P	MOBAY	W. VIRGINIA	2.7
P	DENWOOD	W. VIRGINIA	3.7
P	AREA SOURCE+	W. VIRGINIA	1.0
P	OHIO VALLE MC	W. VIRGINIA	0.1

\+ Area source includes 10 small sources all in the Moundsville-Weirton area all with total annual SO_2 emissions of less than .1 ktonne.

* Vol 46, No 84, May 1, 1981

** Vol 2, No 17, April 24, 1981

N - cited by New York, P - cited by Pennsylvania

TABLE 1 a

Small SO_2 Sources Listed as Area Source in Table 1

		Source	Location	
P	1.	Cities Services	Moundsville	W. Virginia
P	2.	Dieckmar & Sons	(Moundsville)	W. Virginia
P	3.	Taylor, Smith, & Taylor	Chester	W. Virginia
P	4.	Triangle Conduit	Glendale	W. Virginia
P	5.	U. S. Stamping	Moundsville	W. Virginia
P	6.	Valley Camp Coal	Moundsville	W. Virginia
P	7.	National Steel Corp's Brown Island	Weirton	W. Virginia
P	8.	National Steel Corp's Brown Island	"	W. Virginia
P	9.	Mainland Coke	"	W. Virginia
P	10.	Wheeling Pittsburgh's Follensbee	Follensbee	W. Virginia

Annual Wet Deposition of Sulphur

Total Magnitude and Percentage Contribution of the 53 Sources

Cited by Pennsylvania and New York* to the Total

Sensitive Region	Total Wet Sulphur Deposition ($g/m^2/yr$)	Amount due to 53 Sources Listed	Amount due to 0.2 $g/m^2/yr$ 'Background'	Amount due to Sudbury 1979 Emissions	Amount due to Other Canadian Sources	Amount due to Other US Sources
Muskoka-Haliburton, Ontario	0.67	6.4	29.6	15.1	6.1	41.8
Algoma, Ontario	0.47	4.3	41.8	9.7	14.9	28.8
Lakehead, Ontario	0.28	2.9	70.8	1.3	4.8	19.9
Val D'or, Quebec	0.61	4.0	32.5	12.0	25.4	25.6
Adirondacks, N.Y.	0.83	8.4	23.9	4.1	5.7	56.4
West Pennsylvania	1.94	24.2	10.3	0.4	0.7	61.2

*"Federal Register", Vol. 46, No. 84, May 1, 1981
"Inside EPA", Vol. 2, No. 17, April 24, 1981

NOTE: Model Predictions have been verified to be accurate within a factor of 2 with 60% of estimates within 35% of expected values.

T14

LONG-TERM AVERAGE SO_4 CONCENTRATION

TOTAL MAGNITUDE AND PERCENTAGE CONTRIBUTION OF THE 53 SOURCES

CITED BY PENNSYLVANIA AND NEW YORK* TO THE TOTAL

Sensitive Region	Long-Term Average Sulphate Concentration (micrograms/m^3)	Amount due to 53 Sources Listed	Amount due to Sudbury 1979 Emissions	Amount due to Other Canadian Sources	Amount due to Other US Sources
Muskoka-Haliburton, Ontario	3.43	11.3	9.9	10.9	67.9
Algoma, Ontario	2.13	10.4	8.5	16.1	65.0
Lakehead, Ontario	0.98	11.0	3.8	14.7	70.5
Val D'or, Quebec	2.76	9.6	10.7	21.6	58.1
Adirondacks, N.Y.	4.59	13.1	4.3	10.2	72.4
West Pennsylvania	7.65	20.9	0.9	3.1	75.1

*"Federal Register", Vol. 46, No. 84, May 1, 1981
"Inside EPA", Vol. 2, No. 17, April 24, 1981

Long-term Average SO_2 Concentration

Total Magnitude and Percentage Contribution of the 53 Sources Cited by Pennsylvania and New York* to the Total

Sensitive Region	Long-term Average Sulphate Concentration (Micrograms/m^3)	Amount due to 53 Sources Listed	Amount due to Sudbury 1979 Emissions	Amount due to Other Canadian Sources	Amount due to Other US Sources
Muskoka-Haliburton, Ontario	7.86	8.1	26.1	13.0	52.8
Algoma, Ontario	4.40	6.0	20.5	32.7	40.8
Lakehead, Ontario	0.96	8.9	5.1	21.9	64.1
Val D'or, Quebec	6.98	4.5	20.7	45.7	29.1
Adirondacks, N.Y.	10.64	10.3	5.8	14.1	69.8
West Pennsylvania	33.35	28.2	0.3	1.7	69.8

*"Federal Register", Vol. 46, No. 84, May 1, 1981
"Inside EPA", Vol. 2, No. 17, April 24, 1981

GRAHAM W.S. SCOTT, Q.C.
DEPUTY MINISTER
THE ONTARIO MINISTRY OF THE ENVIRONMENT

CLOSING REMARKS

HEARINGS ON INTERSTATE POLLUTION ABATEMENT
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C.
JUNE 19TH, 1981

WE HAVE BEEN PRESENTING TECHNICAL EVIDENCE OF TRANSBOUNDARY POLLUTION FOR TWO REASONS. THE FIRST IS TO ILLUSTRATE TO YOU IMPACTS ON THE NEW YORK, PENNSYLVANIA, AND ONTARIO REGION. EVIDENCE OF THIS TYPE WILL BE MORE FULLY PRESENTED AND DOCUMENTED IN OUR WRITTEN COMMENTS TO BE SUBMITTED LATER. WE BELIEVE THAT THIS EVIDENCE IS DIRECTLY RELEVANT TO THE TERMS OF REFERENCE OF THIS HEARING.

THE SECOND REASON FOR OUR TESTIMONY WAS TO DISCUSS OUR EXPERIENCES IN CONSIDERATION AND CONTROLLING AGGREGATED SO_2 SOURCES IN RELATION TO TRANSBOUNDARY POLLUTION, AND TO SHOW YOU HOW WE HAVE USED LONG-RANGE TRANSPORT MODELLING IN THE CONSIDERATION AND CONTROL PROCESS.

SINCE THIS ISSUE IS CENTRAL TO THESE HEARINGS, AND SINCE IT IS COMPLEX, WE WANTED TO SHOW YOU THE DIFFERENT KINDS OF EVIDENCE WE HAVE ACCUMULATED FOR THE CONTROL OF TRANSBOUNDARY POLLUTION. WE REALIZE THAT THE EVIDENCE ITSELF MAY NOT ALL BE DIRECTLY RELEVANT TO THIS HEARING, BUT WE FEEL THAT OUR USE OF THE INFORMATION IN CONJUNCTION WITH MODELLING TO FORMULATE AND IMPLEMENT POLICY IS RELEVANT AS A "CASE STUDY". A FULL ACCOUNT OF THIS WILL BE SUBMITTED TO YOU, BUT I WOULD NOW LIKE TO BRIEFLY DESCRIBE WHAT OUR PHILOSOPHY IS AND GIVE YOU TWO EXAMPLES OF HOW WE ARE USING IT IN OUR POLICY MAKING PROCESS.

IN GENERAL, CONCERN ABOUT AN ENVIRONMENTAL ISSUE ARISES FROM SCATTERED EVIDENCE RELATED TO OBSERVATIONS. MANY OF THE RECENT AND CURRENT ISSUES ARE EMPLOYING MATHEMATICAL MODELLING TO HELP RESOLVE WHAT ACTION SHOULD BE TAKEN.

IN THE CASE OF LONGER-RANGE TRANSPORT, WE FEEL IT WOULD BE WRONG AS REGULATORS TO IGNORE THE AVAILABLE MODELS. A SUFFICIENT NUMBER OF THEM EXIST IN EUROPE AND NORTH AMERICA. INTERCOMPARISON OF MODELS WITH DATA SHOWS THAT THEY DO HAVE MERIT.

ON THE OTHER HAND, THE MODELS HAVE UNCERTAINTY IN THEIR RESULTS, AND DIFFERENT MODELS MAY DIFFER SOMEWHAT IN SOME OF THEIR RESULTS. UNDER THESE CONDITIONS, AS REGULATORS, IT WOULD BE UNWISE TO RELY SOLELY ON MODELS.

WE MUST REALIZE THAT ALL DECISION MAKING INVOLVES UNCERTAINTY -- THE DEGREE OF UNCERTAINTY DETERMINES THE VALUE OF A DECISION.

WE CANNOT DISCOUNT MODELLING RESULTS JUST BECAUSE THEY MAY DEVIATE FROM OBSERVATIONS. CLEARLY, THIS DEVIATION IS EXPECTED AND HAS TO BE ACCOUNTED FOR EXPLICITLY IN THE PROCESS OF DECISION MAKING. FURTHERMORE, IT IS IMPORTANT TO REALIZE THAT EMISSION CONTROL WILL RESULT IN A DEGREE OF REDUCTIONS IN CONCENTRATIONS AND DEPOSITION WHICH MAY BE DIFFICULT TO QUANTIFY.

THEREFORE, AS A DECISION MAKER, I HAVE TO ACCEPT THIS UNCERTAINTY IN MODELLING AND USE THE BEST TOOLS AVAILABLE TO ACCOUNT FOR UNCERTAINTY IN DECISION MAKING. IN ONTARIO, WE ARE NOW USING THE FOLLOWING PHILOSOPHY IN DECISION-MAKING:

1. WE DEVELOP LONG-RANGE TRANSPORT MODELS. THEN WE EXPOSE THE MODELS TO RIGOROUS AND OPEN PEER REVIEW, AND TEST THE MODELS AGAINST FIELD DATA. WE REQUIRE THE QUANTIFICATION OF UNCERTAINTIES.
2. AFTER THE FIRST ROUND OF THIS HAS BEEN COMPLETED, WE INSERT THE MODELS INTO THE REGULATORY PROCESS IN A GUIDELINE FASHION. THE UNCERTAINTIES IN THE RESULTS ARE DOCUMENTED AND DISCUSSED.
3. PRIOR TO MAKING A DECISION WHICH IS RECOMMENDED ACCORDING TO MODELLING RESULTS, WE ASSEMBLE AS MUCH EVIDENCE FROM OTHER INFORMATION SOURCES AS POSSIBLE.
4. THE IMPERATIVE ENVIRONMENTAL BENEFITS RESULTING FROM ACTION ARE WEIGHED AGAINST THE ECONOMICS AND ENVIRONMENTAL LOSS RESULTING FROM INACTION DUE TO UNCERTAINTY. A STEP-BY-STEP APPROACH EMPLOYING INTERIM ACTIONS MAY BE WARRANTED IF THERE IS AN IMMEDIATE NEED, BUT THE UNCERTAINTIES ARE LARGE. AS RESULTS BECOME MORE DEFINITE, FURTHER STEPS CAN BE TAKEN.

5. WHEN THE MODELS HAVE PASSED THE POINT OF EXHAUSTIVE TESTING, REVIEW, AND COMPARISON WITH OTHER DATA, THEY CAN BE INCORPORATED INTO THE REGULATORY PROCESS IN A BINDING WAY, KEEPING IN MIND THE NEED TO PERIODICALLY UPDATE THEM AS THE STATE OF THE ART PROGRESSES.

I WOULD NOW LIKE TO ILLUSTRATE HOW WE HAVE IMPLEMENTED THIS PHILOSOPHY IN THE CONTROL OF INCO AND ONTARIO HYDRO.

IN THE CASE OF INCO, WE HAD A LARGE BODY OF EVIDENCE SHOWING EFFECTS IN ONTARIO FROM SO_2 AND ACID DEPOSITION IN ONTARIO. WE ALSO HAD EVIDENCE WHICH INDICATED THAT SOME OF THIS DAMAGE COULD BE DUE TO INCO. ON THE OTHER HAND, WE HAD INDICATIONS THAT INCO WAS NOT THE SOLE CAUSE OF THE PROBLEM. THESE DATA WERE EXAMINED IN THE LIGHT OF THE LONG-RANGE TRANSPORT MODEL. THE CONSISTENCY BETWEEN MODEL RESULTS AND DATA GAVE US THE CONFIDENCE REQUIRED TO FURTHER EMPLOY THE MODEL TO PREDICT ENVIRONMENTAL BENEFITS TO U.S SENSITIVE AREAS, AS WELL AS THOSE IN ONTARIO AND THE REST OF CANADA, AND ENABLED US TO ASSESS BENEFITS AGAINST COSTS. AN INTERIM PROGRAM OF CONTROL WAS THEN IMPLEMENTED VIA REGULATIONS AND CONTROL ORDER.

IN THE CASE OF ONTARIO HYDRO, WE WERE FACED WITH CONTROL OPTIONS INVOLVING SIX FOSSIL-FUELED PLANTS, THREE OF THEM EMITTING MOST OF THE SO_2 AND NO_x. THE PLANTS WERE OF DIFFERING AGES, AND CONSTRAINTS EXISTED UPON THE TYPE OF CONTROL TECHNOLOGY WHICH COULD BE EMPLOYED BECAUSE THE PLANTS WERE SCATTERED ACROSS SOUTHERN ONTARIO, CUTS OF EMISSIONS AT ANY PLANT WOULD RESULT IN A DIFFERENT BENEFIT TO SENSITIVE AREAS IN THE U.S., ONTARIO, AND OTHER PARTS OF CANADA.

TO EVALUATE SYSTEMATICALLY THE COSTS AND BENEFITS OF SPECIFIC CONTROL OPTIONS, SOURCE RECEPTOR RELATIONSHIPS WERE DEVELOPED FROM OUR MODEL AND COMBINED WITH PLANT-BY-PLANT COST FUNCTIONS. LINEAR MATHEMATICAL ANALYSIS WAS THEN USED TO COMPUTE COSTS AND DEPOSITION REDUCTIONS.

CONCLUSIONS FROM THIS ANALYSIS WERE DISCUSSED WITH THE UTILITY, AND A REGULATION WAS ISSUED TO ESTABLISH THE INTERIM EMISSIONS CONTROL PROGRAM ON A SYSTEM-WIDE BASIS.

I THINK YOU CAN SEE THAT WE HAVE LEARNED A GREAT DEAL IN DEALING WITH OUR AGGREGATE SO_2 SOURCES, TO HELP SOLVE LONG-RANGE TRANSPORT POLLUTION PROBLEMS.

ON BEHALF OF ONTARIO, I THANK YOU AGAIN FOR GIVING US THE OPPORTUNITY OF PARTICIPATING IN YOUR DECISION-MAKING PROCESS. I THINK IT AUGURS WELL FOR RELATIONS BETWEEN OUR TWO NATIONS.

FROM THE EVIDENCE PRODUCED DURING THESE TWO DAYS, SOME TRUTHS ARE MANIFEST. TRANSBOUNDARY AIR POLLUTION FROM AGGREGATIONS OF SOURCES EXISTS. IT EXISTS IN THE CONTEXT OF THESE HEARINGS, FROM THE MID-WESTERN POWER PLANTS TO PENNSYLVANIA AND NEW YORK. IT ALSO AFFECTS ONTARIO. THE FACT OF TRANSBOUNDARY FLOW AS SHOWN HERE CANNOT BE IGNORED.

WE HAVE HEARD A GREAT DEAL OF TALK HERE ABOUT HISTORY, EMISSION HISTORY, METEOROLOGICAL HISTORY, HISTORICAL STATISTICS. THESE HAVE THEIR USES, BUT WE ARE IN A FUTURE-ORIENTED PROFESSION. WE CANNOT RE-CAST THE PAST, WE CANNOT PROTECT AGAINST HISTORY.

OUR EXPERIENCE LEADS ME TO BELIEVE THAT WE CAN HELP YOU APPROACH YOUR PROBLEM AND WE WISH TO ADVANCE THESE RECOMMENDATIONS IN THE SPIRIT OF COOPERATION WHICH IS TRADITIONAL BETWEEN OUR NATIONS:

THE FIRST NEED IS RECOGNITION. THAT'S WHAT THIS HEARING IS ABOUT. I AM CONFIDENT EPA MUST RECOGNIZE THE PROBLEM EXISTS, AS THE EVIDENCE OVERWHELMINGLY DEMONSTRATES. AS ENVIRONMENTAL PROTECTORS, WE MUST STAND GUARD FOR OUR CITIZENS. WE MUST NOT ALLOW ANY INCREASES IN EMISSIONS WHICH COULD CONCEIVABLY CAUSE CONTINUED OR FURTHER DAMAGE TO OUR ENVIRONMENT.

ONLY THEN WILL WE HAVE THE LUXURY OF TIME IN WHICH THE SCIENTISTS CAN COMPLETE THEIR WORK, AND GIVE US THE BASIS FOR A LONG-TERM AND LASTING SOLUTION TO THIS PROBLEM.

THANK-YOU.

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A submission to the United States Environmental Protection Agency hearing on interstate pollution abatement.

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